OCT 20 1924

Printed on Thin Paper for Foreign Circulation
THE ENGINEER," OCTOBER 10, 1924

BRITISH EMPIRE EXHIBITION NUMBER—No. 25.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C.2.

VOL. CXXXVIII.—No. 3589] LONDON: FRIDAY EVENING, OCTOBER 10, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

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PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES:—
STEEL FISH BOLTS AND NUTS.
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Assistant Engineers (2) REQUIRED by the GOVERNMENT of NIGERIA, for the PUBLIC WORKS DEPARTMENT, for two tours of not less than 12 nor more than 18 months' service, with possible extension. Salary £400 a year for first three years of service, then £510, rising to £720 a year by annual increments of £30, and thereafter to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25 to 35, preferably unmarried, must have had good general education and be A.M.I.C.E., or hold equivalent qualifications. They must have had proper technical training and have had not less than two years' subsequent experience on large engineering or municipal works. Preference given to candidates with experience of waterworks construction.—Apply at once by letter, stating age, qualifications, and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting reference M/12,963. 7178

Assistants (Two) REQUIRED by the GOVERNMENT of CEYLON for service in the Architectural Office of the PUBLIC WORKS DEPARTMENT, for a period of three years, with possible permanency. Salary £500, rising to £560 a year by annual increments of £30, and thence (if appointment is made permanent) to £960 a year, payable locally in rupees at the Government rate of exchange of 15 rupees to the £. Free passages. Candidates, preferably unmarried, aged 28-30, must have passed the examination for Associate Membership of the R.I.B.A. or for the Membership of the Society of Architects, and have had special experience in the actual Design and Construction of Reinforced Concrete Buildings, and of Steel Frame Buildings.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/12,945. 7180

Civil Service Commission. FORTHCOMING EXAMINATION: PROBATIONARY INSPECTORS in the Engineering Department of the General Post Office (17-20, with extension for service in H.M. Forces), 20th November.
The date specified is the latest on which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1. 7050

Northern Polytechnic Institute, HOLLOWAY, LONDON, N. 7.
LECTURER REQUIRED in STRUCTURAL STEEL and REINFORCED CONCRETE. One afternoon per week, 1.30-4.30. Fee 30s.—Apply to the SECRETARY, giving full particulars. 7177

Aberdeen Corporation Water-Works.
TORRY MAIN—CAST IRON PIPES AND PIPE LAYING.
The Town Council of Aberdeen are prepared to receive TENDERS for:—
(1) The SUPPLY of ½ MILE of 9in. diameter CEMENT-LINED CAST IRON PIPES and SPECIALS.
(2) The LAYING of the above PIPES.
The drawings may be inspected and specification, schedule of quantities and form of Tender obtained on and after 23rd October, 1924.
For each specification a deposit of Two Pounds Sterling will be required, which sum will be returned to the tenderer, provided that he shall have sent in a bona fide Tender and shall not have withdrawn the same.
The employment of labour shall be in accordance with the conditions of the Unemployment Grants Committee.
Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for Piping," are to be addressed to the undersigned. No Tender delivered after 9 a.m. on 16th October, 1924, will be considered.
The Town Council do not bind themselves to accept the lowest or any Tender.
GEORGE MITCHELL, M. Inst. C.E., F.R. San. I., Water Engineer.
Water Engineer's Office,
414, Union-street, Aberdeen.
30th September, 1924. 7148

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for:
8000 VOLUTE SPRINGS.
Specification and form of Tender can be obtained at the Company's Offices, 192, Gresham House, Old Broad-street, E.C. 2, on or after 6th October, 1924.
A fee of 20s. will be charged for the specification, which is not returnable.
Tenders must be submitted not later than Noon on Thursday, 16th October, 1924.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS, Secretary.
7142

Bombay, Baroda, and Central India Railway Company.
The Directors are prepared to receive up to Noon on Friday, 24th October, TENDERS for the SUPPLY of PAINTS, &c.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG, Secretary.
Offices: 91, Petty France, Westminster, S.W. 1,
8th October, 1924. 7171

PUBLIC NOTICES

Bombay, Baroda, and Central India Railway Company.
ELECTRIFICATION OF BOMBAY SUBURBAN LINES.
The Directors are prepared to receive TENDERS for the SUPPLY of the following PLANT, namely:—
1. ELECTRICAL EQUIPMENT OF COACHES.
Fee for specifications £2 per copy.
Specifications and forms of Tender (which must be submitted in duplicate) may be obtained at this office on or after October 13th, 1924, on payment of the fee for specification, which payment will not be returned.
Tenders must be sealed and addressed to the undersigned, marked "Tender for Electrical Equipment of Coaches," and delivered not later than Noon on Monday, December 15th, 1924.
The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Bombay, Baroda and Central India Railway Company.
The Directors do not bind themselves to accept the lowest or any Tender.
The Consulting Engineers, to whom application for any further technical information may be made, are Messrs. Merz and McLellan, 32, Victoria-street, Westminster, S.W. 1.
S. G. S. YOUNG, Secretary.
Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1.
3rd October 1924. 7152

East Indian Railway.
The Directors are prepared to receive up to 11 a.m. on Wednesday, the 29th instant, TENDERS for the SUPPLY of—
FOUR-WHEELED OPEN GOODS WAGONS.
Copies of the specification can be obtained at the Company's offices, on payment of £1 1s. each. This fee will not be returned.
G. E. LILLIE, Secretary.
73/76, King William-street, London, E.C. 4.
9th October, 1924. 7188

The Municipality of Singapore.
TENDERS FOR STEEL PIPES, VALVES, &c.
Sealed TENDERS, addressed to Messrs. C. C. Lindsay and Peirce, 180, Hope-street, Glasgow (Agents to the Municipality of Singapore), endorsed "Singapore Municipality—Tender for Steel Pipes, Valves, &c.," will be received until 5 p.m. on Friday, the 31st October, 1924, for the SUPPLY and DELIVERY at Singapore of about SIX MILES of WELDED STEEL PIPE, 33in. internal diameter; about SIX MILES of WELDED STEEL PIPE, 36in. internal diameter; about SIX MILES of WELDED STEEL PIPE, 39in. internal diameter; together with certain CAST IRON PIPES, VALVES and SPECIALS. Though lap-welded steel pipes are specified, tenderers are at liberty to offer other makes of steel pipes, but riveted pipes will not be accepted, and whatever make of pipe may be offered must be of British material and manufacture. Forms of Tender and specification may be obtained on and after the 10th October, 1924, from Sir Alex. Binnie, Son and Deacon, 20, Buckingham-gate, Westminster, S.W. 1, or from the Agents to the Municipality, on receipt by either of them of a cheque to the value of £5 made out to the Agents, Messrs. C. C. Lindsay and Peirce, which amount will be returned on receipt of a bona fide Tender. Drawings may be seen at the offices of Messrs. Sir Alex. Binnie, Son and Deacon. The lowest or any Tender will not necessarily be accepted, nor will any expenses in connection with tendering be defrayed. No Tenders will be considered except from actual manufacturers capable of supplying the pipes at the rate of 90 of each size per fortnight, together with a proportionate number of specials.
C. C. LINDSAY and PEIRCE,
180, Hope-street, Glasgow,
Agents to the Municipal Commissioners of Singapore. 7157

PUBLIC NOTICES

Sale by Private Treaty.
RECORD ENGINEERING CO., Ltd., Tutbury, near Burton-on-Trent, manufacturers of Internal Combustion Engines, Lehrs, &c., and Iron-founders.
The RECEIVER for the Debenture Holders of the above Company is prepared to receive TENDERS for the PURCHASE of the FREEHOLD LAND and BUILDINGS, GOODWILL, PATENTS, PLANT and MACHINERY, STOCK-IN-TRADE and BOOK DEBTS of the Company.
Particulars and conditions of Tender may be had on application to S. B. SAUNDERS, F.A.A., 26, Parkrow, Nottingham, or at the Offices of the Company at Tutbury.
Tenders should be addressed to the said S. B. SAUNDERS at Nottingham, where they will be opened and should be delivered not later than Twelve Noon on 18th day of October, 1924. The highest or any Tender will not necessarily be accepted. 7134

St. Andrew's Hospital, Thorpe, NEAR NORWICH.
The Committee of Visitors invite TENDERS for the LAGGING of STEAM MAINS, BRANCHES, HOT WATER and RADIATION PIPES, CONDENSERS, and CALORIFIERS, approximately 3500ft., with ASBESTOS or FOSSIL MEAL; also approximately 100 FLANGE BOXES.
Specification and particulars to be obtained from the Resident Engineer at the Hospital.
Tenders to be addressed to the Chairman of the Committee and to be delivered at the Hospital by 4th November, 1924.
The Committee do not bind themselves to accept the lowest or any Tender.
W. E. HANSELL, Clerk to the Committee of Visitors.
The Close, Norwich. 7149

The Commissioners of Public Works, Dublin, will be prepared to receive up to Twelve Noon on 21st October, 1924, OFFERS for the LETTING on LEASE of the OIL FUEL INSTALLATION at Beal Lough, Berehaven, Co. Cork, comprising Two Oil Tanks with necessary fitments, each having a capacity of 2,006,600 gallons, with Pier, Pipe Line, and Mooring Facilities.
Full particulars of the installation may be obtained on application to the undersigned.
The Commissioners will not be bound to accept the highest or any Offer.
By Order,
J. J. HEALY, Secretary.
Oifig Oibreach Puibli (Office of Public Works),
Baile Atha Cliath (Dublin),
G7909 4th October, 1924. 7155

The Great Indian Peninsula Railway Company, of 48, Copthall-avenue, London-wall, E.C. 2, invite TENDERS for:—

		Fee 10s.
1.	MILD STEEL BARS, SECTIONS, &c.	
2.	DRYSALTERIES, &c.	7s. 6d.
3.	STEEL SPIKES, PINS, AND WASHERS	2s. 6d.
4.	POINTS AND CROSSINGS, &c.	2s. 6d.
5.	BRIGHT DRAWN MILD STEEL BARS (for use in Automatic Lathes)	2s. 6d.
6.	LINOLEUM	7s. 6d.
7.	CARRIAGE DOOR HANDLES, HINGES, &c.	2s. 6d.
8.	ROLLED STEEL DISC WHEELS AND AXLES FOR C. AND W.	10s.

Tenders are due by 11 a.m. on 21st October, 1924. Tender forms obtainable at above address. Fees not returnable. 7182

PUBLIC NOTICES

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—
1. STEEL RAILS and FISH-PLATES.
2. CAST IRON PIPES.
3. PORTLAND CEMENT.
4. WAGONS.
Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.
Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Steel Rails and Fish-plates," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 24th October, 1924, for Specifications Nos. 1, 2, and 3, and on Friday, the 12th December, 1924, for Specification No. 4.
The Directors do not bind themselves to accept the lowest or any Tender.
A charge, which will not be returned, will be made of 5s. for each copy of Specifications Nos. 1, 2, and 3, and of £1 for each copy of Specification No. 4.
Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.
A. MUIRHEAD, Managing Director.
91, Petty France, S.W. 1.
7th October, 1924. 7172

SITUATIONS OPEN

WANTED, FOUNDRY ORGANISER for Eastern Counties, capable of getting the best out of Foundry Moulding Machinery. Send experience.—Address, 7121, The Engineer Office. 7121 A

WANTED, GENTLEMAN, with Some Engineering experience, to SOLICIT ADVERTISEMENTS and OBTAIN SUBSCRIBERS for a prominent Engineering Journal. Good commission. Previous experience essential.—Address by letter only, "COMBUSTION," Africa House, Kingsway, London, W.C. 2. 7175 A

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FOR SALE or HIRE, ELECTRIC MOTORS, from 60 to 300 H.P.; PORTABLE STEAM ENGINES, from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 37, Queen Victoria-street, London, E.C. Tel., City 3035. Ex.

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WANTED, COPIES of "THE ENGINEER." Containing Two-page Supplements of Working Drawings of 4-4-2 Loco., North-Eastern (NOVEMBER 3rd, 1911), and 4-6-0, L.S.W.R. (JULY 21st, 1911).—F. NEALE, 11, Mount Pleasant-crescent, Hastings. P9670 J

A WELL-KNOWN ENGINEERING FIRM REQUIRES PETROL ENGINES of 15 H.P. at 700 revolutions and 32 H.P. at 600 r.p.m. to replace higher speed engines with gears. Prices quoted so far have been too high.—Address, with full particulars, 7197, The Engineer Office. 7197 I

TRANSLATIONS, to or from Any European Language, accurately executed by Technical Staff; also Typing or Facsimile Printing of Specifications, Contracts, Letters, &c.—DANKS and CO., 199, Strand, W.C. 2. Tele., City 6119. P9616 I

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WANTED, FOUR or SIX-WHEEL COUPLED TANK LOCOMOTIVE, standard gauge, working pressure 140 to 180 lb. per sq. in. Must not be earlier than 1912. Price, all particulars and copy of last insurance report.—Address, 7180, The Engineer Office. 7180 F

WANTED, ONE 250-TONS HYDRAULIC PRESS, daylight about 10 to 12ft., stroke about 2/3ft., column centres as wide as possible, but not less than 7ft. 6in., working pressure 1500 lb., 2-column type preferable.—Address, 6996, The Engineer Office. 6996 F

WANTED, SPEAKE DYNAMOMETER, for Testing Petrol Engines up to 100 H.P.—Address, 7185, The Engineer Office. 7185 F

AGENCIES

AGENCY WANTED by Qualified Engineer having office, for engineering specialty or materials suitable steam users or works. District, North-East Coast.—Address, 7160, The Engineer Office. 7160 D

ENGINEER'S AGENTS WANTED to Represent Old-established company manufacturing well-known appliances for Water-tube and Lancashire Boilers. Leeds and Newcastle districts. Applicants must have established connections and cover districts by motor. State full particulars.—Address, 7183, The Engineer Office. 7183 D

GENTLEMAN, Who Has Been for Many Years with G London merchant, DESIRES to REPRESENT Northern or Midland MANUFACTURER of Machine or Small Tools as agent in London and South.—Address, P9654, The Engineer Office. P9654 D

OLD-ESTABLISHED FIRM of CRANE BUILDERS in Lancashire are OPEN to APPOINT SOLE AGENTS in London An Commission Basis. Full particulars.—Address, 7154, The Engineer Office. 7154 D

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FOR SALE, a Valuable PATENT PROCESS for CASTING HIGH-SPEED STEEL (Tungsten) for tools, i.e., milling cutter lathe tools, &c.; also large quantity of METAL PATTERNS for same.—Address, P9661, The Engineer Office. P9661 E

THE PROPRIETORS of BRITISH PATENT No. 129,614, dated January 24, 1922, relating to "Safety Padlocks," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE or otherwise on reasonable terms for the purpose of MANUFACTURING same in Great Britain and ensuring full development and practical working.—Address enquiries to A.C.T.L., 4, Rue Troschet Paris. 7133 E

THE PROPRIETOR of BRITISH PATENT No. 26,396/13, dated November 17, 1913, relating to "Sheet Metal Culverts," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, 28, East Jackson Blvd., Chicago, Illinois. 7151 E

THE PROPRIETORS of PATENT No. 158,739, "Improvements in Mechanical Stokers," are DESIROUS of ENTERING into ARRANGEMENTS by way of LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the same and ensuring its full development and practical working in this country.

All communications should be addressed in the first instance to J. E. EVANS-JACKSON and CO., Registered Patent Agents, Bath House, 57/60, Holborn-viaduct, London E.C. 1. 7174 E

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AIR COMPRESSORS, ALL FOR 100 lb.—
BELT-DRIVEN:
50ft. Broom and Wade, nearly new; £40.
113ft. Peltier and Morcom, 2-stage; £85.
250ft. Consolidated, S.R. type, enclosed; £95.
STEAM-DRIVEN:
NEW, 245ft. Globe Pneumatic, 8in. type; £190.
400ft. Sentinel, vertical 2 stage; £240.
1600ft. Sentinel, vertical, 1930, as new; £860.
AIR RECEIVERS—all for 100 lb.:
6ft. by 2ft. 6in., Vertical all fittings complete; £16.
9ft. by 3ft., Vertical, all fittings, complete; £32.
18ft. by 4ft., Horizontal, no fittings; £42.
16ft. by 3ft., Vertical, built of 7-8in. plate, all seams double riveted, a really fine vessel, fit for 500 lb. w.p.; £45.
Many small Compressors and Receivers.
Every size of Fan and Blower kept in stock.
Very large stock of FOUNDRY PLANT.
ALEX. HAMMOND, FOUNDRY MACHINERY MERCHANT, "BOXTED," SLOUGH. 7153 G

BELT-DRIVEN "TANGYES" TWO-THROW RAM PUMP, 5½in. dia. rams, approx. 4000 g.p.h. Belt-driven TWO-THROW GEARED RAM PUMP rams 4in. dia. by 6in. stroke, cap. 3000 g.p.h.
2 Vertical TWO-THROW GEARED Belt-driven RAM PUMPS, 4in. dia. ram by 4in. stroke, cap. 1200 g.p.h. at 60 revs.
Horizontal Duplex STEAM PUMP, 10in. by 7in. by 10in., by Worthington.
TREBLE-BARREL DEEP WELL PUMP, 5in. bore by 14in. stroke, with pumping frame, suitable for direct steam or belt drive.
2 New Electric-driven "REES-ROTURBO" PUMPS, 1000 g.p.h., for 440 volts D.C.
Horizontal COMPOUND STEAM ENGINE, h.p. cyl. 9in., l.p. cyl. 14½in. by 14in. stroke.
Horizontal Single-cylinder STEAM ENGINE, 10½in. cyl. by 20in. stroke.
STEAM CAPSTAN, by Clarke-Chapman, 9in. dia. cyls.
2 Vertical AIR RECEIVERS, with dished ends, 7ft. high by 6ft. 8in. dia. by 5-8in. plate.
RADIAL DRILLING MACHINE, with arm 6ft. 6in. long, auto. and hand feed.
4½in. centre LATHE, S.S. and S.C., 8ft. gap bed.
New 6in. centre LATHE S.S., S.A. and S.C., 6ft. gap bed.
STANLEY ENGINEERING CO., Bath. Ex.

E. S. HINDLEY and SONS, Bourton, Dorset, offer the following ENGINES FOR SALE at BARGAIN PRICES:—
One New Compound Vertical Enclosed Steam Engine, suitable for 150 lb. pressure, with underbase and compound Dynamo, 110 volts, 20 K.W., 500 revs. Can be sold without dynamo if desired.
One New Three cylinder Vertical Gas Engine, 50/60 B.H.P. Can be supplied for belt drive or direct coupled to dynamo.
One Re-conditioned Five-cylinder Vertical Gas Engine, 80/90 B.H.P. Can be supplied for belt drive or for direct coupling to dynamo.
One Tandem Compound Steam Engine, steam jacketed cylinders, 11in. by 16in. by 30in. stroke, extended shaft and outer bearing, in excellent condition. Can be seen at work. 7049 G

FOR SALE, LANCASHIRE BOILERS (3), by Horsfield's, Dewsbury, 30ft. long by 8ft. 6in. dia., 80 cross tubes, guaranteed for 160 lb. pressure. All mountings and fittings.—WILLIAMS, 37, Queen Victoria-street, London. 7107 G

FOR SALE, LANCASHIRE BOILERS (3), by Danks, 30ft. long by 8ft. 6in. dia., with Hopkinson's fittings, for 160 lb. pressure. Low price before removal.—WILLIAMS, 37, Queen Victoria-street, London. 7108 G

FOR SALE, ECONOMISER, by Green's, 512 Pipes, new 1916, guaranteed to re-insure for 190 lb. pressure. All fittings as now fixed.—WILLIAMS, 37, Queen Victoria-street, London. 7110 G

FOR SALE, LANCASHIRE BOILERS (2) by Gimson and Chaimter, 1903, long by 8ft. 6in. dia., no cross tubes, for 160 lb. pressure. Low price before removal.—WILLIAMS, 37, Queen Victoria-street, London. 7160 G

FOR SALE, LANCASHIRE BOILERS (2), by Yates and Thom's, 30ft. long by 8ft. 6in. dia., with Hopkinson's fittings, for 160 lb. pressure. Practically new.—WILLIAMS, 37 Queen Victoria-street, London. 7106 G

FOR SALE.—No. 3 Gray's METAL CUTTER, Cap 36in. deep, 5.8in. thickness mat, floor space 8ft. 7in. by 5ft. 10in. GEAR HOBBING MACHINE, by Wallwork, 28in. slotted table, for worm wheels, spirals &c. all complete.—Address, 7166, The Engineer Office. 7166 G

FOR SALE, ONE Excellent 5-TON GRAYTON SHUNTING CRANE, new in 1918, and in perfect condition.—JOSEPH PUGSLEY and SONS, Ltd., Cattybrook Ironworks, Lawrence Hill, Bristol. 7164 G

FOR SALE or HIRE, BOILERS, 2 Loco. Type, 25 and 30 N.H.P., Ruston and Robey, 160 lb. pressure, mountings and fittings; immediate delivery; low terms.—J. T. WILLIAMS and SONS, South Bermondsey Station, London, S.E. 16. 7115 G

For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

The Transport of Large Electrical Machinery.

With the increasing size of generating plants used in power stations, the problem of transporting the turbine and generator from the makers' works to the power station becomes yearly a more difficult one. Where such larger machinery has to be placed on board ship the difficulty is perhaps not so great, but more often it must be transported by road or rail, and then the problem of transport is raised in a very acute form. We recently described in these columns the shipping of the Chicago turbine and alternator at Newcastle, which involved a 78-ton stator, and not so long ago the General Electric Company was able to dispatch a 50-ton stator by rail from Birmingham to Manchester for shipment to Australia. In a more recent case, the problem was not so simple. This time the General Electric Company, Limited, wished to transport a 62-ton stator from its Witton Works at Birmingham to the power station of the St. Marylebone Corporation, London. Such a heavy and bulky piece of machinery could not, we are informed, be carried on any of the railways connecting Birmingham with London, and there were grave doubts as to transport by road on account of defective roads and lightly constructed bridges. Ultimately the firm of H. Bentley and Co., Limited, of Bradford, undertook the work. The stator when packed was about 12ft. square by 11ft. 2in. high, and it was accommodated on a special truck with two four-wheel swivel bogies. Two traction engines were employed to draw the total load of 75 tons, and a further engine was available for steep gradients. One route had to be abandoned on account of insufficient headroom under a bridge, while in many cases steel plates had to be laid down to distribute the load when crossing service mains and in places where the road surface was suspected. Altogether ten days were occupied in removing the stator from Witton Works to Marylebone Power Station. The problem of transporting such machinery is one which deserves the careful attention of railway and road transport authorities.

The Passing of Raw Coal as Fuel.

In an address given to the past and present students of the Wigan Mining College on Saturday last, Mr. Frank Hodges made the statement that the world was inevitably passing away from the use of raw coal as fuel, and that the world market for raw coal was on the decline. Mr. Hodges instanced the rapid increase in oil fuel used, both for marine and for land transport. To-day, he said, we were paying abroad something like £45,000,000 per year for motor spirit and oil fuels, while over 200,000,000 gallons of motor spirit was imported each year. The high price of such fuels crippled our motor industry and rendered motor transport costly. Moreover, our aircraft, road transport and part of the Navy were dependent on foreign supplies of liquid fuel. In order to maintain and increase the world's supply of oil, it would be necessary to make use of the products derived from the carbonisation of shale and coal. The United States, he said, had already realised that fact, and had secured over 60,000 square miles of oil shale bearing lands in Colorado, Utah and Wyoming. In a similar way the French Government was making a determined effort to render France independent of imported foreign liquid fuel. It was very necessary, Mr. Hodges said, for Great Britain to face the problem of coal distillation, for such an industry would give valuable supplies of home produced fuel and by-products, and would at the same time reduce the extensive unemployment in the coal trade which unfortunately prevailed.

Glasgow's Subway.

The scheme for the reconstruction of the Glasgow Subway Railway, which, it will be remembered, was acquired some two years ago by the Corporation, has now been approved by the Tramways Committee, and parliamentary sanction is to be sought for carrying out the work. The total cost of the proposed reconstruction scheme is estimated at £1,000,000, in addition to £385,000, which was the price paid to the Glasgow Subway Company for the existing cable driven undertaking. Part of the work will comprise the construction of two siding loops one on each of the present tunnels. The new loops are to have separate entries and exits at the Buchanan-street and St. Enoch-square Stations, and they are to be of such a length as to accommodate all the present running stock with about half as many new cars. With the consent of the London, Midland and Scottish Railway an entrance to the underground booking hall of the Subway will be made from St. Enoch Station and passenger lifts provided. New station tunnels are to be constructed at St. George's Cross and Kelvinbridge, while the station entrances and passenger lifting facilities will be improved generally. A suggested maximum speed of at least 30 miles per hour between stations, which is two and a-half times the speed of the present cable system, has been put forward. Certain defects will have to be overcome if this speed is employed, and it is recommended that the design of the new cars and the rail gauge should be held in abeyance until some further investigations have been made. Although the diameter of the tunnel is somewhat smaller than that in use on the London Tube Railways, it is hoped to introduce a new type of car which, it is stated, will be in some respects an advance upon the general design in use in London.

The Telephone Development Association.

An announcement has now been made concerning the objects of the recently formed Telephone Development Association. We are given to understand that the new body has been launched by British Manufacturers who are directly or indirectly interested in the telephone industry. In expressing the hope that the Association may speedily develop into a central body competent to deal with all questions affecting the industry—in particular those affecting the telephone user—attention is called to the unsatisfactory position of Great Britain with regard to telephone usage. For every thousand inhabitants we have to-day only 21 telephones in use, as compared with 59 in Norway, 83 in Denmark, and 143 in the United States. One of the immediate tasks of the Association will be to examine the present situation and to seek to remedy any defects found. The question may be put as to whether the manufacturers are to blame for not turning out the right type of instrument, or whether it is not that the British public, broadly speaking, has failed to visualise the telephone as one of the essential services of modern business and social life. An attempt will be made to popularise the telephone by means of explanatory publicity, which will endeavour to throw light upon the many uses and amenities which the telephone and its auxiliary services yield. In this manner it is hoped to develop the use of the telephone and to create employment in the manufacture, maintenance, and administration of more telephones throughout the country. The chairman of the Telephone Development Association is Sir Alexander Roger, and its managing director Sir Basil Clarke. The Association's offices are at Aldine House, 10, Bedford-street, Strand, and Mr. H. E. Powell-Smith is the secretary.

The North Orbital Road.

During last week a series of meetings was held at the Ministry of Transport to discuss in a preliminary manner a new project, known as the North Orbital Road, and the scheme was explained in broad outline by Mr. C. H. Brassey, chief engineer of the Roads Department. The projected road will follow a roughly semi-circular course at a radius of about 22 miles from Charing Cross. It is proposed to start on the east at Tilbury, and skirting Brentwood, Ongar and Hoddesdon, to proceed by way of Hatfield, St. Albans and Rickmansworth to a terminus on the Bath road at Slough. The total length of such a course is about 75 miles, and for the greater part of the distance there are existing roads, which could be straightened and widened, so as to conform to the proposed scheme. At the present time there is no immediate question of building the new road, but it is desired, by taking timely steps, to avoid the creation of obstructions and to embody the line of route in town-planning schemes and estate development projects. There is little doubt that many of the towns bordering upon the suggested route would welcome the new road as a means of relieving congestion in existing older thoroughfares, and the linking up of small townships might have a co-ordinating influence on the planning schemes already proposed or in process of being carried out. It is also quite possible that certain sections of the road might lend themselves to execution by unemployed labour, should the need arise. The project is certainly one which merits the careful study of the local authorities affected by it.

The Light Aeroplane Competitions.

A series of trials of light aeroplanes of the two-seater type fitted with dual control and engines of not more than 1100 cubic centimetres cylinder capacity were concluded at Lympne on Saturday last. As in the preceding year, interest was continuous throughout the trials, and within thirty-five minutes of the close of the competition the result was undecided. The Air Ministry prize of £2000 was gained by the Beardmore Wee Bee monoplane, with an ungeared Bristol Cherub engine. The machine was flown by Mr. M. W. Piercey at a speed of 70.11 miles per hour in the high-speed trials, and it gained the highest total marks. Mr. Piercey flew a total of 737½ miles during the trials in 11 h. 54 min. 41 sec. A Bristol Browne monoplane flown by Mr. C. F. Uwins, also fitted with a Cherub engine, was awarded the second prize, and it also gained the Duke of Sutherland's prize for the best getting off and landing qualities. The Hawker biplane fitted with an A.B.C. engine and flown by Mr. F. P. Raynham secured the second prize for the same tests, and had not engine trouble developed just at the close of the high-speed trials there is little doubt that this machine would have been well in the running for the Air Ministry prize. Another machine which gained two prizes offered by motor manufacturers' societies for the greatest number of completed circuits flown was the Cranwell Sociable biplane fitted with a Cherub engine and flown by Flight-Lieutenant N. Comper, who flew during the trials a total of 762½ miles in 17 h. 53 min. 18 sec. Some fourteen machines took part in the trials, which yielded it is to be considered, valuable results. The lessons to be learned from the Lympne 1924 competition will be discussed at meetings which are to be held by the Royal Aeronautical Society and the Institution of Aeronautical Engineers.

Wireless Telephones for Cross-Channel Boats.

Some experiments which have recently been concluded at Southampton foreshadow interesting developments in connection with the use of wireless telephony for direct communication between dock authorities and incoming and outgoing cross-Channel vessels. The work has been carried out by the Western Electric Company, Limited, on behalf of the Southern Railway Company, and final tests of the instruments were made during the homeward voyage of the ss. Dinard from St. Malo to Southampton. The apparatus employed consisted of a 50-watt transmitter and a three-valve receiving set, and a wave length of 250 m. has so far been used with conspicuous success. During the tests the first call was made when the vessel was but 1½ hours out from the French port—a distance of 130 miles from Southampton—and even at this range, which exceeds that for which the instruments were designed, all the conversation was quite clearly heard. Calls were put through at each succeeding half hour, and, as would be expected, there was a noticeable increase in the strength of the voice as the ship neared Southampton. There seems but little doubt that telephonic communication between the land and ships at sea will soon be an accomplished fact. No elaborate tuning, it is stated, will be required, and the instruments are designed to be handled by an unskilled operator. Such installations should do much to facilitate rapid docking, and they should also prove a considerable convenience to ships' commanders when the vessel is nearing port, when it is necessary to communicate information to the shore.

Battleships versus Aircraft.

Under the chairmanship of Admiral Eberle, Chief of Naval Operations, a board of inquiry is about to meet in Washington to determine the relative value of surface vessels, particularly battleships, and aircraft as instruments of national defence. This board has been appointed at the instance of President Coolidge, who is said to have been much impressed with the recent world flight of American army aviators. Out of this achievement a discussion has arisen in the United States as to whether the progress of aviation does not foreshadow the complete revolution of naval tactics as now conceived. Apparently the affirmative view is held by many American authorities, though it is not easy to understand why the world flight should have revived this issue in an acute form. The inquiry, however, is welcomed by American naval officers, who are confident that the battleship will be vindicated when the evidence on both sides has been heard at length. Meanwhile the Budget officials propose to reduce by several millions the vote for maintaining the battle fleet, a course that would necessitate the laying up of many ships. The money thus saved would be spent on increasing the naval air forces, though it is not explained how the additional aircraft could be employed at sea without more aircraft carriers, for which no provision is contemplated. Admiral Moffett, who is in charge of the United States naval air service, issues a warning to the effect that, while air power is essential to a modern fleet, command of the sea can be secured and held only by means of surface vessels. It would, he thinks, be suicidal for the United States to abolish its battleships and place sole reliance on aircraft as a means of defence against attack from the sea.

Cyfarthfa Ironworks.

The announcement that Cyfarthfa Works at Merthyr Tydvil has been acquired by Thos. Ward and Co., Limited, of Briton Ferry and Sheffield, and that the blast-furnaces, stoves and blowing machinery will be dismantled, recalls the history of these famous works. They were founded in 1765, and at the close of the eighteenth century were among the largest ironworks in the world, employing over 1000 men. One hundred years ago the number of men employed had increased to 5000 and the mills could turn out over 6000 tons of rails per month. Later on the ironworks were converted for the production of Bessemer steel, and they were operated until 1890 by private owners. In that year a limited company was formed to operate them, and about twelve years later the undertaking was acquired by Guest, Keen and Nettlefolds, Limited. During the war the Cyfarthfa plant was employed on munition work, but it was closed down nearly five years ago. The works, which are now to be dismantled, have been famous in the iron and steel trade for more than a century and a-half.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XXV.*

GENERAL ENGINEERING EXHIBITS.

WORTHINGTON-SIMPSON, LIMITED.

THE principal exhibit on the stand of Worthington-Simpson, Limited, of Newark-on-Trent, is the large 48in. centrifugal pump—illustrated by Fig. 470—which is one of four manufactured for the Littleton Pumping Station of the Metropolitan Water Board.

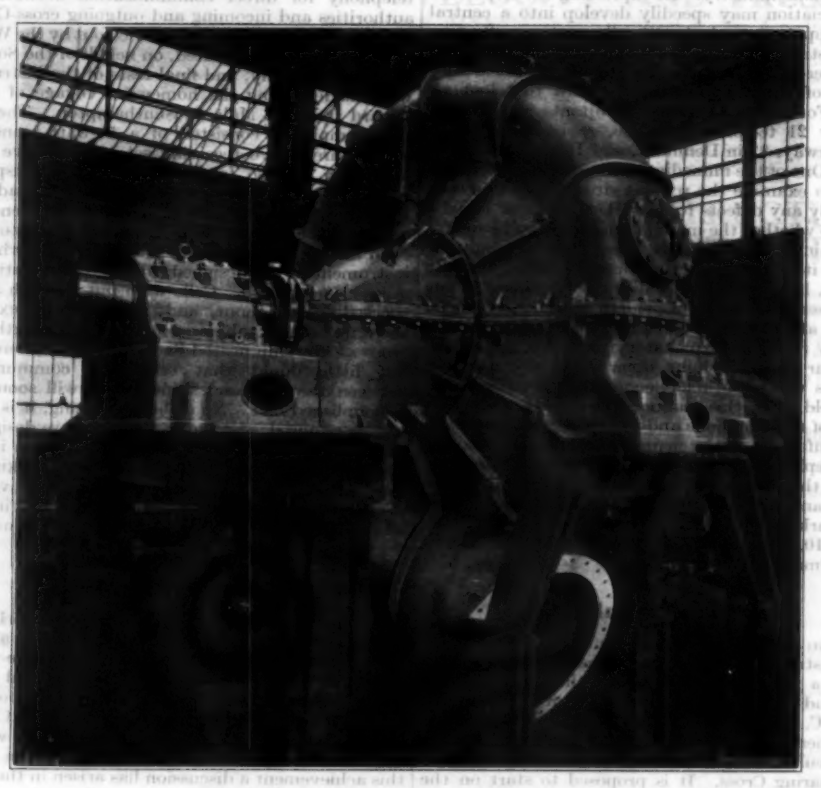


FIG. 470—48-INCH CENTRIFUGAL PUMP—WORTHINGTON-SIMPSON

The total capacity of these pumps is 350,000,000 gallons in 24 hours, and each pump will be driven, in actual service, by a 750 horse-power uniflow engine. The engines, also by Worthington-Simpson, are to be directly coupled to the pump and run at 125 revolutions per minute.

Besides a number of smaller pumps, of both centrifugal and direct-acting types, there is also on this stand a complete surface-condensing plant, capable of dealing with 11,000 lb. of steam per hour from a high-pressure turbine, and able to maintain a vacuum of 28½in. with the barometer standing at 30in., and cooling water at 65 deg. Fah. This plant is illustrated by the general arrangement drawing—Fig. 471—from which it will be seen that the whole of the apparatus is mounted on one base and is driven by a single electric motor.

The condenser itself has a cast iron shell and headers, with an exhaust opening 30in. in diameter. The cooling surface amounts to 1200 square feet, and is provided by ¾in. diameter tubes No. 18 S.W.G. thick. The tube plates are of rolled brass.

The cooling water, which flows along the length of the condenser twice, is provided by a 12in. split-casing centrifugal pump running at 1450 revolutions per minute, and capable of delivering 1500 gallons of water per minute against a head of 30ft.

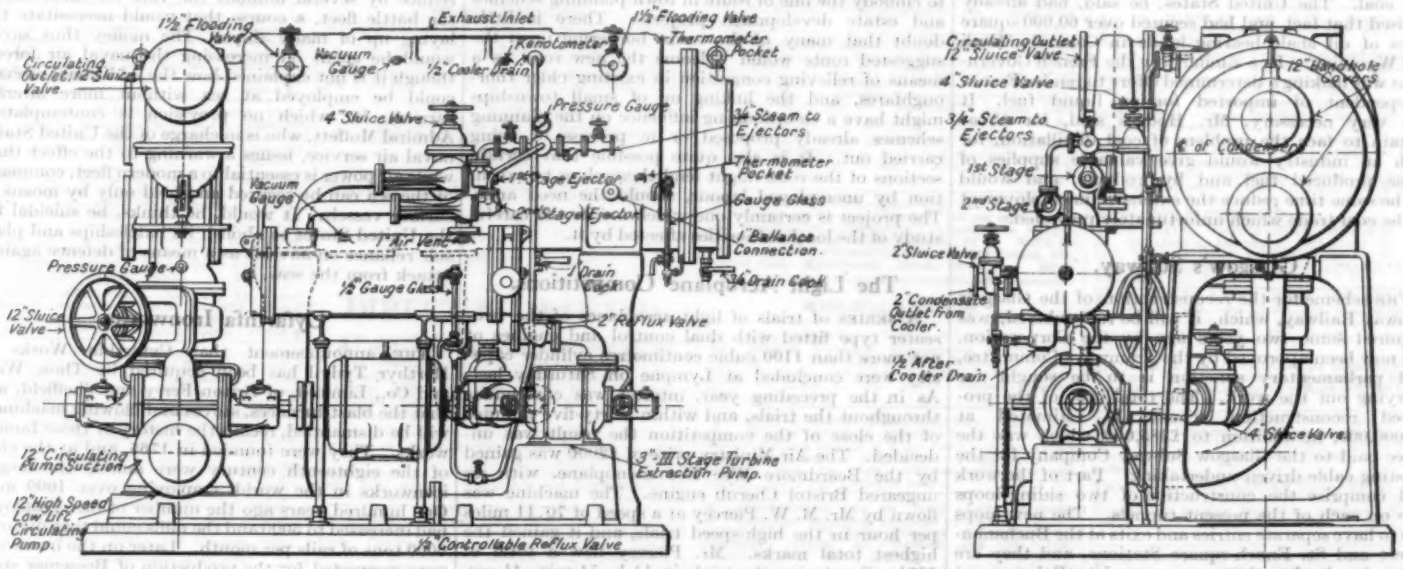


FIG. 471—SELF-CONTAINED CONDENSING PLANT—WORTHINGTON-SIMPSON

Instead of employing an air pump a two-stage ejector is used, the first stage of which sucks the air out of the upper part of the condenser and delivers into an intercooler, from which the uncondensable vapours are taken by the second stage and discharged into an aftercooler. The feed-water is passed through these coolers, and consequently recovers the heat of the steam used by the ejectors. The apparatus is intended to deal with 8½ lb. of air per hour which, the makers consider, is as much as may be expected in the exhaust from a high-pressure turbine of the size named. When supplied with steam at a pressure of 130 lb. per square inch and superheated 50 deg. Fah., the ejector jets have a steam consumption of 200 lb. per hour.

The water of condensation is taken from the bottom of the main condenser by a 3in. three-stage turbine-type of pump, capable of working against a head of 50ft., including the vacuum. Both the circulating and extraction pumps are arranged on one base, on either side of the motor. The power required theoretically to drive the pumps is 23 horse-power, but the makers recommend the use of a 26 horse-power motor running at 1450 revolutions per minute.

AITON AND CO., LIMITED.

Some interesting examples of pipe work are exhibited on the stand of Aiton and Co., Limited, Derby. The examples shown extend from welded flanged pipes, branches and vessels for the high pressures and temperatures now coming into use in power station practice, to cast iron and welded steel pipes for low-pressure work. One of the low-pressure exhibits is a steel pipe 18in. in diameter with a right-angled bend at one end and a right-angled branch halfway along its length, the whole made from a number of plates ¼in. thick welded together by the quasi-arc process. Chief attention among the pipe work exhibits should perhaps be directed to the corrugated pipes in which the firm specialises. We illustrate two examples in Fig. 472. These pipes are made from either solid drawn or lap-welded tubes, but the exact process of their manufacture has not been disclosed to us. An examination of some sections exhibited shows that in the process of production the original thickness of the pipe walls is increased in the finished pipe at least at the crests and troughs of the corrugations. The principal advantage claimed for this type of pipe is the increased flexibility conferred by the corrugations when the pipe is formed into a bend. Compared with an ordinary expansion bend of the same dimensions, a corrugated bend can, it is stated, accommodate 5½ times the expansion or alternatively, to accommodate a given amount of expansion, the size of the bend required can be very greatly reduced by using a corrugated pipe. The bending is performed after the pipes have been corrugated. Up to a diameter of about 12in. the bending may, although it is not altogether advisable, be performed cold. It is therefore a very easy matter to make small adjustments to an expansion bend during erecting operations. These corrugated pipes, we are informed, are now in use for steam at 350 lb. pressure and 700 deg. Fah. temperature.

Another exhibit on Messrs. Aiton's stand is an example of the P. and B. evaporator, which is manufactured by the firm under licence for P. and B. Evaporators, Limited, 75, Victoria-street, London S.W. 1, to the designs originally prepared by Messrs.

* No. XXIV. appeared October 3rd.

Prache and Bouillon, of Paris. This form of evaporator, it is claimed, gives a completely de-aerated supply of distilled water at 212 deg. Fah., having a purity only equalled by distilled water produced by

FIG. 473—CORRUGATED PIPES—AITON

laboratory methods. It is applicable to many purposes, but special attention is drawn to its merits as a means for the production of make-up feed water for boilers. We illustrated and described this form of evaporator in our issue of May 12th, 1922, and now give a more detailed description of it.

Referring to Fig. 473, which is diagrammatic only, the plant consists essentially of a preheater P, a thermo-compressor A, and a heating chamber B, with an ebullition chamber C. The crude water is supplied to the system from the float feed tank G and enters through an opening at the bottom of the preheater, in which a rapid circulation of water is maintained by means of a motor-driven impeller. The water, whilst passing through the preheater tubes at a speed of 11.5ft. per second, is heated by vapour obtained at atmospheric pressure from the ebullition chamber C to a temperature of approximately 210 deg. Fah., at which temperature no steam is generated. During this process a proportion of the heated water is continuously extracted from the preheater and led through a decanting chamber H and a hand-regulated valve to the evaporator, through the tubes of which a rapid circulation of water is similarly maintained. Live steam enters the system through the nozzle 1 of the thermo-compressor A and passes, together with the vapour entrained from the ebullition chamber C, through openings 2 into the expanding nozzle 3, and thence at a temperature of approximately 223 deg. Fah. to the outer walls of the tubes in the heating chamber B. Here the water which is in rapid circulation is raised in temperature, and, in passing through the ebullition chamber C, liberates steam at approximately 212 deg. Fah. Part of this vapour is used for the preliminary heating of the water in the preheater, and part is entrained by the thermo-compressor. The distilled make-up water, which is obtained from the steam condensed on the tubes of the evaporator and the preheater, is collected in the horizontal interconnecting pipes, shown in the diagram, and is discharged automatically through the overflow valve L to a storage tank. Provision is made for oxygen, carbon dioxide or other non-condensable gases to be liberated automatically through suitable vents to the atmosphere.

Considering the process in its thermal aspect, for each pound of live steam passing through the thermo-compressor 1.75 lb. of vapour are entrained from the ebullition chamber C, so that a total of 2.75 lb. of steam at 223 deg. Fah. and 18 lb. per square inch absolute pressure is carried forward into the heating chamber B of the evaporator. The conditions are thus produced for the formation in the ebullition chamber C of 2.75 lb. of steam at 212 deg. Fah., 1 lb. of which passes into the preheater and is condensed, while the remainder becomes entrained by the thermo-compressor. The aggregate of the steam condensed in the two heating chambers and the preheater thus amounts to 2.75 + 1, or 3.75 lb. of distilled water per pound of live steam used. The distilled water so obtained is discharged into the make-up tank at boiling temperature and is gas free.

The formation of scale is, it is claimed, entirely prevented. At the speed of circulation maintained in the heater tubes the stream line flow of water breaks down, and turbulent flow is established. Further, the pressure inside the tubes is greater than that corresponding to the saturation temperature of the water, so that the formation of steam, and, consequently, the precipitation of the solids in solution, cannot take place until the water leaves the tubes. These facts are sufficient to prevent scaling in many cases, but where special conditions exist an abrasive consisting of white quarry sand may be introduced into the system at the point M in suitable quantity. No wear on the tubes, it is stated, is to be feared if the abrasive is used in correct proportions. It has never, we are told, been found necessary to replace tubes under five years' service, and never on account of abrasive action. The scale-forming compounds and impurities are collected by the extraction pipe F arranged in the downcomer column of the evaporator, and are continually drawn off from the system through the discharge branch of the automatic valve N. The two impellers producing the water circulation are driven through chains by a small electric motor.

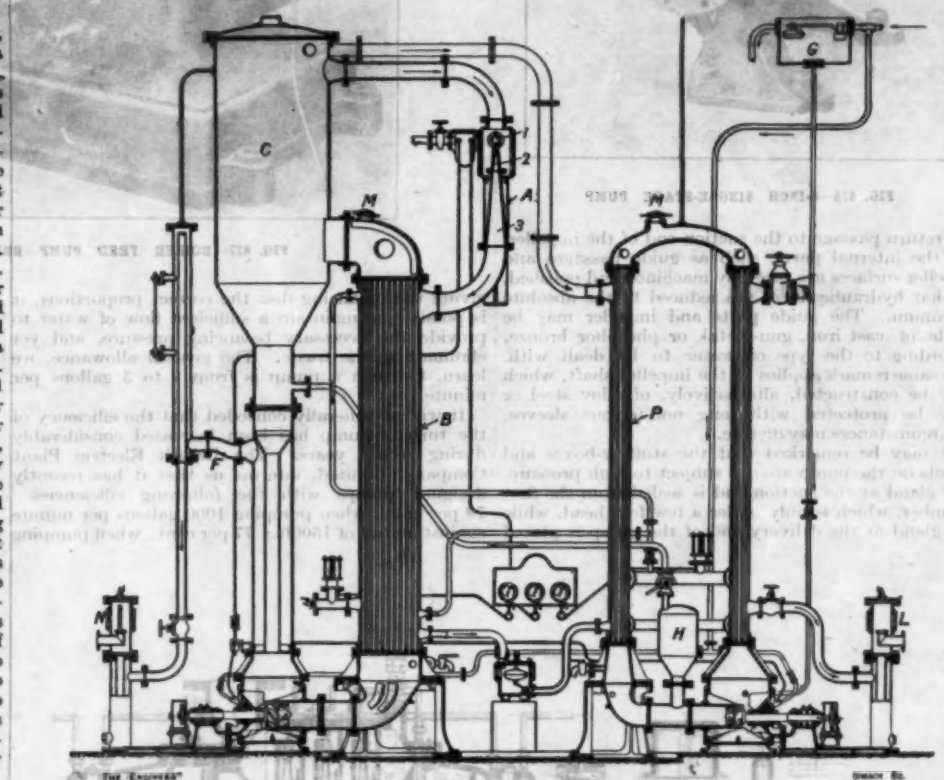


FIG. 472—P. AND B. EVAPORATOR—AITON

THE BRITISH ELECTRIC PLANT COMPANY, LIMITED.

The machinery which is exhibited by the British Electric Plant Company, Limited, of Alloa, Scotland, includes examples, both of electrical plant and pumping machinery, the majority of which has been specially constructed for mining work. The firm has been engaged in such work for upwards of twenty years, and since 1907, in particular, it has given special attention to the design of centrifugal and high-lift turbine pumps. Noteworthy among the pumping plants shown is a six-stage motor-driven high-lift pump, built for an output of 650 gallons per minute when running at a speed of 1500 revolutions per minute and pumping against a total head of 750ft.

The sectional drawing, Fig. 474, shows the pump and motor, which are mounted on a common bed-plate. A slip-ring induction type of motor is employed. It is rated at 200 brake horse-power, and is designed for three-phase 50-cycle current at a pressure of from 400 to 440 volts. Referring to the drawing, it may be noted that the individual stages are registered one into the other and that they are clamped together by bolts, which are passed through the two end covers. These covers, it will be seen, are provided with substantial supporting feet, and they are also made to carry the suction and delivery branches. Such a

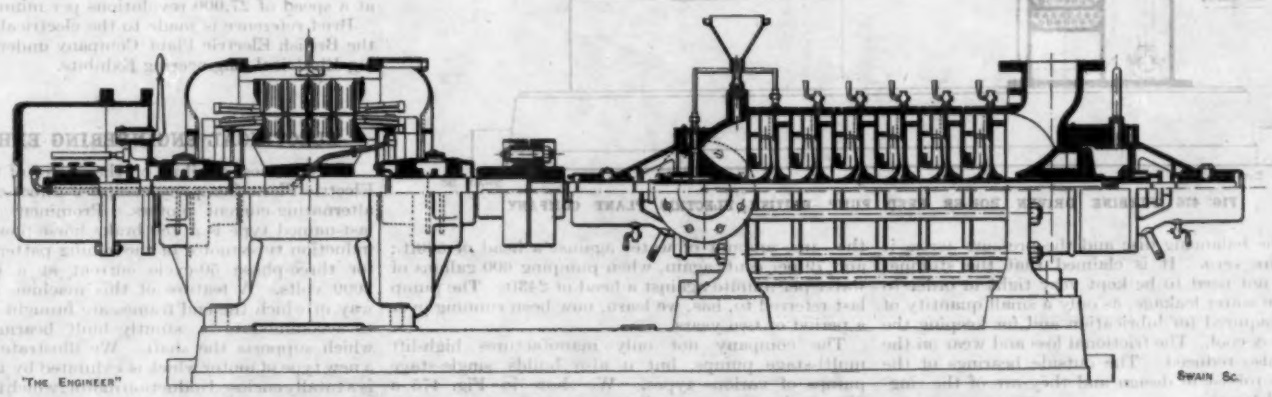


FIG. 474—SIX-STAGE MOTOR-DRIVEN HIGH-LIFT PUMP—BRITISH ELECTRIC PLANT COMPANY

construction gives, the makers claim, better access for dismantling and inspection than that possible with the casing type of turbine pump. The standard arrangement of pipe branches is shown, but any other positions can, we learn, be equally well met. Each pump stage comprises one chamber, and a closing plate with its impeller and guide passages. It may be noted that each impeller has one neck ring only, and that the ring is furnished with a wide bearing surface. It is stated that in these pumps the design has many advantages over the impeller with two neck rings and balancing holes through the webs, and that the efficiency and life of the pump is increased by the reduced frictional and leakage losses in the neck ring chamber bushes. On the delivery side, the neck ring is continued, so that it forms part of the wall of

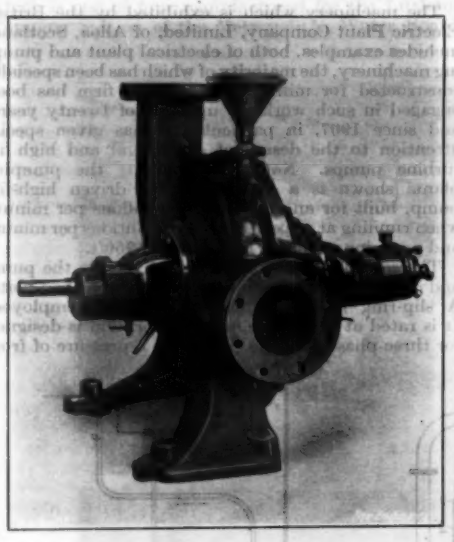


FIG. 475—6-INCH SINGLE-STAGE PUMP

the return passage to the suction end of the impeller. All the internal parts, such as guide passages and impeller surfaces are carefully machined and polished, so that hydraulic losses are reduced to the absolute minimum. The guide ports and impeller may be made of cast iron, gun-metal, or phosphor bronze, according to the type of water to be dealt with. The same remark applies to the impeller shaft, which may be constructed, alternatively, of alloy steel or may be protected with long non-ferrous sleeves, as circumstances may dictate.

It may be remarked that the stuffing-boxes and glands on the pump are not subject to high pressure. The gland at the suction end is sealed from the first chamber, which is only under a few feet head, while the gland at the delivery end of the pump is placed

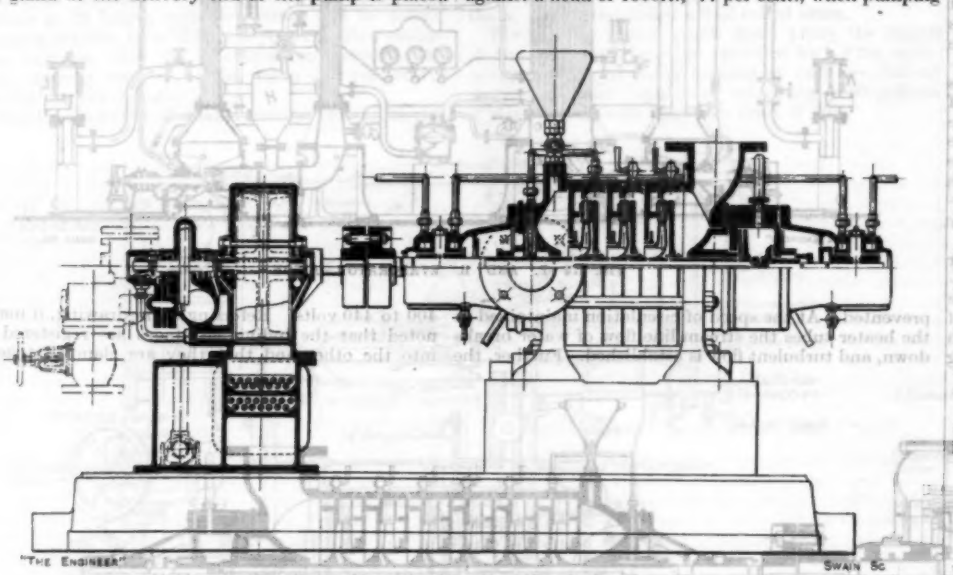


FIG. 476—TURBINE DRIVEN BOILER FEED PUMP—BRITISH ELECTRIC PLANT COMPANY

beyond the balancing disc and the pressure across it is therefore zero. It is claimed that the stuffing-boxes do not need to be kept very tight in order to keep down water leakage, as only a small quantity of water is required for lubrication and for keeping the stuffing-box cool. The frictional loss and wear on the shaft is also reduced. The outside bearings of the pump are robust in design and they are of the ring-lubricated type.

The arrangement for balancing the pump hydraulically is a very simple one. As shown in Fig. 474, a small balancing disc is fitted at the delivery end of the pump. Water from the final stage at full delivery pressure passes along the back bearing, and then flows out radially between the balancing disc and the renewable wearing plate. It then escapes into the balancing chamber, which is kept at practically atmospheric pressure, and it is finally led away by an overflow pipe. The end thrust of the pump causes the balancing disc to be forced towards the renewable plate, but friction is prevented by the presence of a film of water at high pressure, which serves the double purpose of keeping the surfaces slightly apart, and at the same time lubricating them. As the water between the two services is at a higher pressure than atmospheric pressure, the disc with the whole of the rotating parts is forced towards the delivery end of the pump, and the end thrust is thus opposed. By

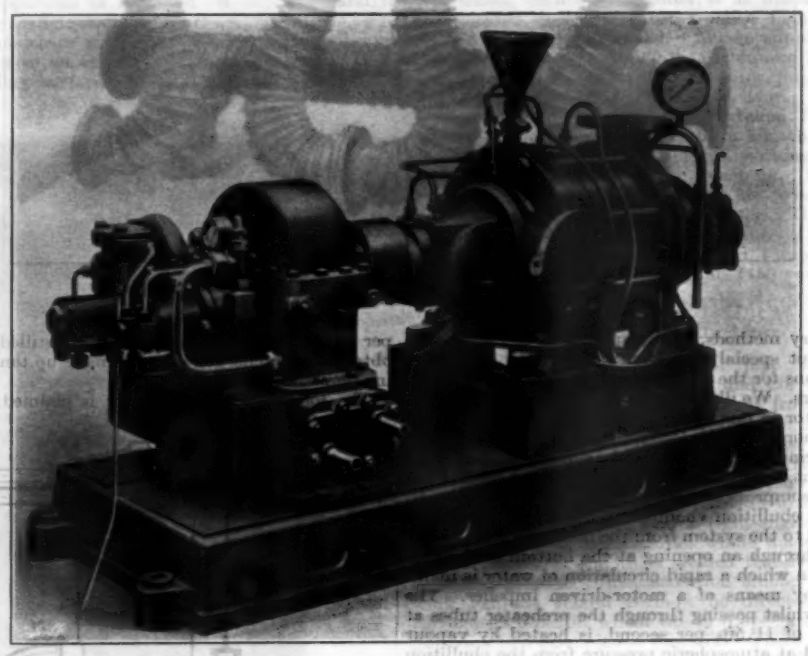


FIG. 477—BOILER FEED PUMP—BRITISH ELECTRIC PLANT COMPANY

giving the balancing disc the correct proportions, it is possible to maintain a sufficient flow of water to provide the necessary balancing pressure, and yet eliminate undue waste. The general allowance, we learn, for such a pump is from 2 to 3 gallons per minute.

It will be generally conceded that the efficiency of the turbine pump has been increased considerably during recent years. The British Electric Plant Company, Limited, informs us that it has recently designed pumps with the following efficiencies—79 per cent., when pumping 1000 gallons per minute against a head of 1500ft.; 77 per cent., when pumping the same amount of water against a head of 800ft.; and 79 per cent. again, when pumping 600 gallons of water per minute against a head of 243ft. The pump last referred to, has, we learn, now been running over a period of two years.

The company not only manufactures high-lift multi-stage pumps, but it also builds single-stage pumps of various types. We show in Fig. 475 a 6in. single-stage pump designed for an output of 700 gallons per minute against a head of 110ft. when running at a speed of 1500 revolutions per minute. A 4in. single-entry 450-gallon duty pump, running at 1750 revolutions and designed for a head of 75ft., is also shown. In the case of the double-entry pump of 6in. and upwards, as shown in Fig. 475, the suction and delivery branches are cast on the main pump body, which also carries the supporting feet. By removing the cover complete, access to the interior of the pump is quickly given. The impeller is furnished with two neck rings, and holes are drilled through the impeller web, which practically eliminates end thrust if the impeller is made to revolve exactly opposite the guide vanes. A small adjustable double-thrust bearing is fixed at the end of one of the main pump bearings, and a special gauge shows whether the impeller is exactly in line with the guide ports. Ring lubricated bearings of ample length are fitted to the pump between the stuffing-boxes and the impeller.

Another interesting exhibit is the turbine-driven boiler feed pump, illustrated by Figs. 476 and 477. This pump has been designed for a duty of 200 gallons per minute at a boiler pressure of 200 lb. per square inch. The pump itself is similar in design to the turbine pump we have already described, and it runs at a speed of 3000 revolutions per minute. It is driven by 50 brake horse-power steam turbine running at 30,000 revolutions which drives the pump through a ten to one single-reduction gearing and a pin type of flexible coupling. The main turbine and gear casing, it may be noted, is cast in one piece, and it is bolted to a strong bed-plate of box section. Part of the bed-plate forms a cooler for the lubricating oil, and the cooling water circulates through a nest of tubes. The main turbine and gear-case covers are separate castings, which facilitate the inspection of either part, while provision is also made for removing the rotor of the turbine without breaking any steam joints.

A simple type of governor is used which is totally enclosed in a casing at the side of the main turbine. It is of the spring-loaded type, and controls an oil-operated relay, which opens or closes the throttle valve. The oil for operating the governor control and also that required for the lubrication of the turbine and the reduction gearing is furnished by a gear type of pump driven from the slow-speed shaft.

The turbine employed is a patented design, and its steam consumption is stated to be 18 lb. per brake horse-power hour when supplied with steam at 200 lb. per square inch and running condensing at a speed of 27,000 revolutions per minute.

Brief reference is made to the electrical exhibits of the British Electric Plant Company under the heading Electrical Engineering Exhibits.

ELECTRICAL ENGINEERING EXHIBITS.

The electrical exhibits on the stand of the British Electric Plant Company comprise direct-current and alternating-current motors. Prominent among the last-named type is a 150 brake horse-power slip-ring induction type motor of the mining pattern, designed for three-phase 50-cycle current at a pressure of 2000 volts. A feature of this machine is the neat way in which the end frames are brought down so as to accommodate a stoutly built bearing pedestal, which supports the shaft. We illustrate in Fig. 478 a new type of motor which is exhibited by the firm. It is a totally enclosed induction motor, which is ventilated by an externally placed fan mounted on the main shaft. The particular machine we illustrate is a slip-ring induction motor complete with brush-raising and short-circuiting gear, and it is designed for a speed of 750 revolutions and an output of 90 brake horse-power. A squirrel-cage motor of 22 brake horse-power of the same type is also shown, and both motors

are designed to operate on a three-phase 50-cycle 440-volt circuit. The construction is novel in that the stator laminations are continued beyond the usual diameter, and are furnished with rectangular closely spaced slots, which run from end to end of the core and provide a large cooling surface. The air provided by the externally placed fan is forced through these slots, and carries away any heat which is generated. There is no connection between the external cooling system and the interior of the machine. It may be appreciated that such a motor is particularly fitted to

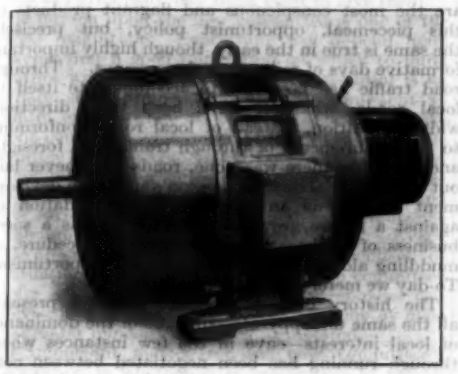


FIG. 478 INDUCTION MOTOR

work in dusty, wet or gas-charged atmospheres, such as may be met with in collieries, flour mills and textile factories. Another advantage of the design is that the size of the motor for a given output can be greatly reduced. This point is illustrated by two 22 horse-power motors, one of the open protected type, and another of the totally closed externally fan-ventilated type, which are placed side by side. Other exhibits shown include a comprehensive series of grid resistances of the "service resistance type."

NALDER BROS. AND THOMPSON, LIMITED.

Some interesting electrical instruments are being shown by Nalder Bros. and Thompson, Limited, of 97a, Dalston-lane, London, E. 8. A characteristic feature of the company's new moving iron power factor meter, constructed under the Nalder and Lipman's patent, is that there are no moving coils and consequently no ligaments or other mechanical arrangements for leading in the current. The needle is free to turn through 360 deg. and the use of buffer stops is consequently unnecessary. It may take up a position in either of the two quadrants on each half of the circular scale, according to whether the current in the circuit is leading or lagging, the pair of quadrants over which the pointer moves being determined by the direction in which the current is flowing—*i.e.*, from the generators to the line or from the line to the generators. These moving iron power factor meters—see Figs. 479 and 480—consist of a fixed and a moving system. In the fixed part there are two sets of coils, termed the field coils and the magnetising coils. The former are energised by the line current either directly or by means of series transformers, whilst the magnetising coils are energised from the

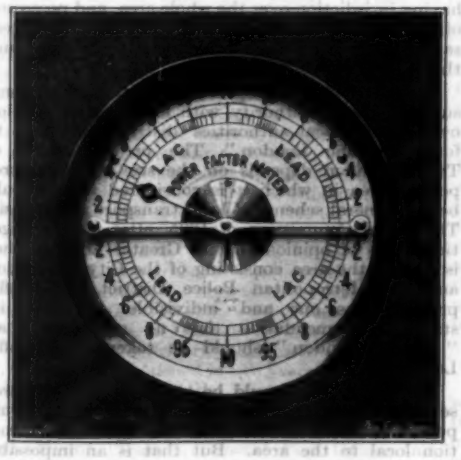


FIG. 479 POWER FACTOR INDICATOR

pressure circuit, either directly or through the medium of potential transformers. The moving system consists of an appropriate number of thin iron plates suitably shaped and attached to a spindle which carries the pointer. The spindle is built up of magnetic and non-magnetic portions and rotates between jewelled centres, and in order to ensure a dead-beat action four light mica vanes are also carried by the spindle. The new construction possesses important advantages, and single-phase and polyphase instruments for balanced or unbalanced loads all give the same degree of accuracy, irrespective of the load.

In practically all existing types of power factor meters, the makers explain, the windings are arranged so as to produce a resultant rotating magnetic field, but exhaustive tests have proved that this construction is undesirable. A disadvantage is that, owing to eddy currents, a "drag" torque is exerted by the rotary field upon the metal in the moving system, and this torque tends to impair the accuracy and efficiency of the instrument. In the instrument under consideration, however, the electro-magnetic forces acting upon the moving iron system are produced by field coils having their axes parallel to each other and in separate parallel planes. Moreover, the moving element comprises a spindle made up of one or more coaxial magnetic systems which are magnetised by

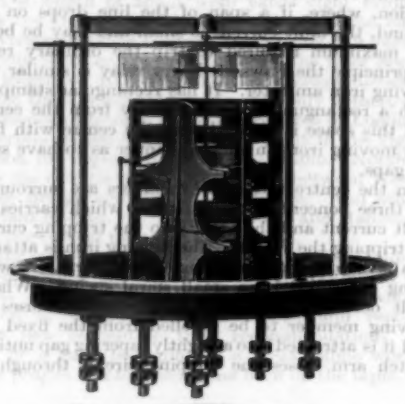


FIG. 480—MECHANISM OF POWER FACTOR INDICATOR

individual pressure coils and an appropriate number of thin iron vanes mounted thereon and in these parallel planes. The distinguishing feature of these phase meters is that no resultant field is set up and consequently there is no "rotational drag torque" upon the moving iron system.

The magnetic fluxes of the current coils oscillate to and fro periodically in parallel planes, whilst the fluxes of the pressure coils oscillate periodically up and down coaxially, thereby magnetising the corresponding iron vanes of the independent magnetic portions of the moving system which are magnetically separated by non-magnetic material. The turning moment of the moving system is developed by virtue of the fact that a number of directive pulsating magnetic forces set up by the field coils are regularly applied to the vanes which are magnetised periodically and in the correct sequence by the pressure coils, and the vanes may be regarded as magnetic levers mechanically displaced with respect to one another. The combined electro-magnetic effect is such that for any given power factor the moving system is in equilibrium and is independent of the load. If the angle between

FIG. 481—FREQUENCY METER

the current and potential difference of the mains alters by a given amount the moving system will shift by an equal amount and will take up a definite and stable position corresponding to the new conditions. The position of the pointer indicates the phase angle, but for the sake of convenience the scale is graduated to give readings in terms of the power factor.

The company's frequency meters—see Fig. 481—have been designed to overcome the disadvantages of the vibrating reed or resonance type of instrument for measuring the periodicity or speed of alternators. The principle of the instruments, which are also manufactured under the Nalder Bros. and Thompson and Lipman's patents, is that resonance occurs in an alternating-current circuit when the reciprocal of the product of the self-induction in henries and the capacity in farads is equal to a constant multiplied by the square of the frequency, so that by properly proportioning the inductance and capacity a resonance circuit may be obtained for any desired frequency, and at this frequency the current will neither lag nor lead with reference to its electromotive force. For a resonant circuit or nearly a resonant circuit there is a rapid change in the power factor of the current flowing through it for comparatively small changes of frequency, and therefore if one of the circuits of a phase-meter be tuned to resonance for a selected or normal frequency any departure from that frequency will be measured by the movable element of the indicator.

The construction of the frequency meter is in general similar to that of the maker's single-phase power factor meter, except that all the coils are wound with

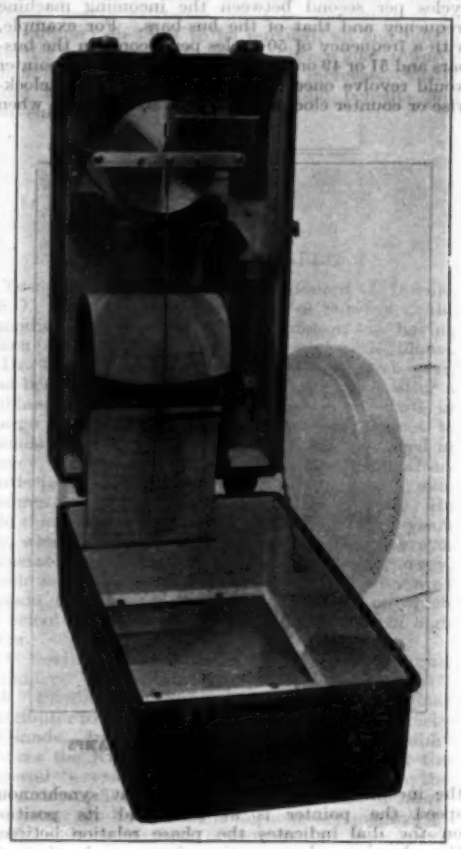


FIG. 482—FREQUENCY RECORDER

fine wire and are connected to two terminals. The moving system carrying the pointer consists of a pivoted spindle which is divided into two magnetic portions, the two soft iron vanes on each portion being set at 180 deg. with respect to each other and the axis of each element being at 90 geometrical degrees to that of the other axis. The movement is very light and extremely dead beat. Fig. 482 shows a graphic recording frequency meter.

The firm's synchroscopes are also on view, both on the stand and in the Exhibition power-house, where

FIG. 483—SYNCHROSCOPE

good displays of other types of Nalder instruments are to be seen on the main switchboard. These synchroscopes—see Figs. 483 and 484—consists of two parts, a fixed and moving system. The fixed system has two sets of coils, termed the field and magnetising coils, the former being connected to the bus-bar terminals of the instrument, whilst the magnetising coils are connected through a phase-splitting device to the "incomer" terminals of the meter. The moving system comprises a spindle having two coaxial magnetic elements separated by non-magnetic material, the two quadrant vanes of

each element being set at 180 deg. with respect to each other and the axis of symmetry of each pair being at 90 geometrical degrees with respect to the other pair.

The combined electro-magnetic force or torque caused by the interaction between the magnetic fluxes of the two combinations of fixed pressure coils causes the moving iron system and the pointer to revolve in one direction or the other according to whether the frequency of the incoming machine is greater or less than the bus-bar frequency. Moreover, the number of revolutions made per second by the pointer is exactly equal to the difference in cycles per second between the incoming machine frequency and that of the bus-bars. For example, with a frequency of 50 cycles per second on the bus-bars and 51 or 49 on the incoming machine the pointer would revolve once per second in a direction clockwise or counter clockwise respectively. Hence when

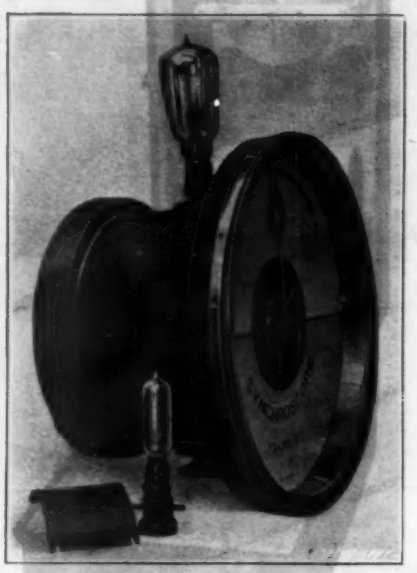


FIG. 484—SYNCHROSCOPE WITH LAMPS

the incoming machine is running at synchronous speed the pointer is at rest, and its position on the dial indicates the phase relation between the bus-bar electromotive force and that of the incoming machine. The speed of the incoming machine is adjusted until the pointer moves round slowly to the vertical mark on the dial, when the paralleling switch may be closed. Since one half of a revolution or about 10in. scale for an 8in. dial instrument corresponds to 180 electrical degrees phase displacement, it will be seen that a high degree of precision is secured. These instruments are also supplied with synchronising lamps which are placed on top of the instrument, as shown in Fig. 484, and with a red, green, and white signalling device.

Examples of the Fawsset-Parry ultra sensitive relay are shown. These relays—see Fig. 485—are very sensitive and are primarily intended for use in

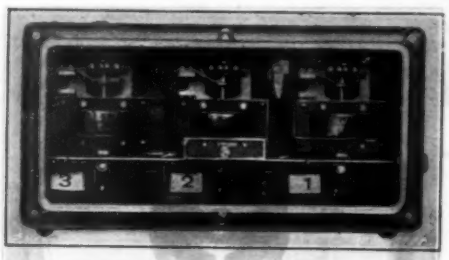


FIG. 485—FAWSSET-PARRY RELAY

connection with the Merz-Price and similar protection systems, and especially the Beard-Hunter compensated pilot system. In the original form of Merz-Price protection the winding of the relay is traversed by a capacity current which flows into the pilot cable and with the usual design of current transformer it is proportional to the current in the feeder that is being protected.

To prevent the relay working under straight-through fault conditions its tripping current must not exceed the maximum value of the capacity current. As a lower current setting cannot generally be used, in most cases the only advantage to be gained from the use of a more sensitive relay is the reduced impedance of the windings allowable. In the case of feeders working at high voltage, and especially feeders of considerable length or cross section, no very marked advantage can be obtained from a more sensitive relay unless the Beard-Hunter compensated pilot is used. The Fawsset-Parry relay shown in Fig. 485, however, easily works with one-tenth of the energy of the ordinary relay, and under these conditions it is very insensitive to external vibration.

The ordinary relay, the makers explain, may be set to trip with .1 volt-ampère, but it is very sensitive to external vibration, and it is necessary to set it up to at least .2 volt-ampère and is commonly set at .8 volt-ampère, whereas the relay under consideration is quite satisfactory at .02 volt-ampère. If the full advantage of the compensated pilot is to be obtained this relay is necessary, and in many cases where straight-through currents are not particularly severe its use, even with existing uncompensated pilot cables, will result in a considerable reduction in the fault setting.

This is a considerable advantage on medium-pressure overhead lines some distance from the power station, where, if a span of the line drops on dry ground, the fault current is small and may be below the maximum required to trip the ordinary relay. In principle the Fawssett-Parry relay is similar to a moving iron ammeter. It has rectangular stampings with a rectangular space cut away from the centre, and this space is bridged near the centre with fixed and moving irons in such a manner as to have small air gaps.

In the centre these iron members are surrounded by three concentric coils, one of which carries the fault current and the other two the tripping current for tripping the switch. The moving iron is attached to a pivoted spindle carrying a switch arm, the whole being controlled by a small spiral spring. When a fault occurs the out-of-balance current causes the moving member to be repelled from the fixed iron and it is attracted into a slightly tapering gap until the switch arm closes the tripping circuit through the

FIG. 486—FLAME-PROOF AMMETER

outer two coils in series. This puts an extra torque on the movement in order to make good contact on the switch arm, and when this contact is closed the outer coil is cut out, thus leaving just sufficient turns to keep the tripping coil closed. By this means a maximum number of switches can be tripped simultaneously by a given battery.

Once the switch arm of the relay makes contact the process of tripping the main switch must go on until the switch is opened. This breaks the trip circuit, and the relay returns to its normal position and is thus self-setting. As oscillograph records show, this construction ensures a quick and certain contact in the trip circuit and makes the trip proof against violent external vibration. As each type and length of line has different constants, the alternating-current coil is wound to suit the conditions. For testing purposes the relays can be operated by hand by means of milled head screws at the top of the case. In the case of oil switch trips requiring more than 90 volt-ampères to operate them an auxiliary relay is fitted into the case and is capable of dealing with trips taking up to 2.5 kilowatts to operate them, *i.e.*, 10 ampères at 250 volts. Indicators which are replaced by hand can be mounted inside the relay case in series with the trip circuit of each pole.

An exhibit of interest to mining engineers is the flame-proof ammeter shown in Fig. 486, which has been designed to comply with the requirements of Clause 127 of the general regulations concerning the use of electricity in mines. The case, which is made of cast iron, has wide machined flanges and is of adequate strength to resist explosive pressure resulting from the ignition of inflammable gas. The case is also fitted with a wired glass front.

The Problem of London Traffic.*

We have grown accustomed, certainly now for twenty years, to talk of the "problem of London traffic." The phrase has been so reiterated as almost to leave us despondent of any, even a limited, solution. With fatalistic resignation we are prepared to associate chaos and confusion as naturally inherent in any scheme of transit and locomotion for a community so great as London. The problem in every age has arisen from the inadequacy of the streets. The want of adequate and proper streets is the very kernel and essence of the London traffic problem. Its repercussions have exercised a restrictive effect upon the development of the whole organisation of the means of transit and locomotion in the Metropolis. London transport has not been evolved on any comprehensive plan which had regard to the general interests of the congeries of separate metropolitan local districts which from time to time have constituted "Traffic London." The means of locomotion have always been provided to afford isolated local facilities, having regard merely to local interests, and taking no consideration of the needs of the whole community. Streets and roads are the most conspicuous and flagrant products of this piecemeal, opportunist policy, but precisely the same is true in the early, though highly important formative days of railways and tramways. Through road traffic has been left to accommodate itself to local roads, whatever have been their direction, width, condition, instead of local roads conforming to the requirements of through traffic. Of foresight and provision there was none, roads were never laid out in the crucial days of London's suburban development to provide an excess of accommodation as against a future growth of traffic. It was a sorry business of haphazard hand-to-mouth procedure, of muddling along the easy road of facile opportunism. To-day we merely reap what has been sown.

The history of metropolitan tramways presents all the same unhappy consequences of the dominance of local interests—save in the few instances where through running has been negotiated between contiguous tramway systems. But in general the interests of through traffic have been neglected. The omnibus position has been shown to be worse. It has been left to the enterprise and prescience of the London General Omnibus Company to provide a comprehensive service by making fat routes pay for lean ones, and long routes provide a working profit in place of a number of unremunerative short routes.

There is much detrimental competition in London which might be replaced to-morrow by co-operation, with infinite benefit to the public, if only those and their constituents responsible for maintaining it were prepared to trample the fire out of the dying embers of old prejudices and animosities. Perhaps the most striking illustration is the competition between the London General Omnibus Company's omnibuses and the tramways of the London County Council. Omnibuses must pass along the same streets as tramways if only to reach points beyond the tramway termini. Where a portion of a route is necessarily common to both omnibuses and tramways, and the remainder is essential to omnibuses, and if competition is to be eliminated on the common length, that can be done, but only by a working agreement providing for the pooling and a fair division between omnibuses and tramways of the receipts taken by both along the whole route. That is urgently necessary in many districts in London, but apparently the devotion to municipal effort in some quarters is so intense that it will tolerate no alliance, however advantageous to the public, between public and private enterprise.

We may indeed be pardoned for asking what is the cause of all this chaos in the special sphere of London transit. The cause is simple, and can be diagnosed with absolute precision.

It has been clearly explained by the Royal Commission of 1905:—"The present unsatisfactory conditions are largely due to the fact that there did not exist in the past any municipal or other authority having jurisdiction over the whole area, and possessed of sufficient power and resources to enable it to deal satisfactorily with the problem of locomotion, and the other questions allied thereto."

Experience has proved the urgent need of some supreme traffic authority with effective jurisdiction over all the local authorities' districts which go to form "Traffic London." The precise extent of Traffic London depends on the size of the metropolitan area in which it is considered there should be one general scheme of local transport and transit. The Royal Commission of 1905, after its investigations, was of opinion that in Greater London, that is to say, the area consisting of the City of London and the Metropolitan Police District, the traffic problem was one and indivisible. It was its strong recommendation that no area less than "Greater London" should be taken as "Traffic London."

The ideal thing would be to set up, for the area selected, an expert traffic dictator with absolute powers to control and regulate all means of locomotion local to the area. But that is an impossible counsel of perfection in these democratic days, especially with so much autonomy prevailing in local government. As the best approximation to the ideal, the Royal Commission urged the appointment of a tribunal of three, who were to be entrusted with important and far-reaching advisory functions, but wielding no powers of compulsion. That recommendation was shelved by the then Government of the day, but for political—not traffic—reasons, which, on the present occasion, it would be improper for me to discuss. Now, after twenty years, the London Traffic Act has set up the "London and Home Counties Traffic Advisory Committee" for the London traffic area, which is substantially the area within a 25 miles radius—excluding Berks—from

* From Sir Lynden Macassey's presidential address to the Institute of Transport, October 6th.

Charing Cross. The new committee is representative of all the major interests concerned in the traffic of this area, and its function is to advise the Minister of Transport on what I may for brevity call the London traffic problem. It will then be left to the Minister of Transport, or the appropriate Government department, when confronted with recalcitrant interests which refuse to carry out the recommendations of the committee, to deal with them either by "peaceful persuasion" or by the exercise of such powers as the Minister or such department may possess and are prepared to exercise, or of such additional powers as Parliament may think right to give them.

The burden upon the new committee is one of the greatest magnitude. Everything will depend upon its laying first a good foundation on which to build its future work. For that, the chief essential is an adequate staff—trained, expert and competent to organise and sustain a continuous inquiry into current conditions of London traffic. Otherwise the committee will become merely a debating society, without initiative or enterprise. The need is paramount that the committee should be constituted at the earliest possible moment, and then commence its labours without one moment's delay. Every day's procrastination increases the difficulties of the situation. It would be wrong for the committee to defer action until a series of heroic remedies can be devised. Much good work can be done at once while greater remedies are being formulated.

An important matter for the new committee's consideration is whether it is practicable to relieve the present pressure of traffic, or to prevent an increase of the pressure, in central London, by some process of what I may call "decentralisation." There is this well-known characteristic of a city's growth—while its zones are moulded mainly under the influences of economic causes and follow in all great cities a well-known series of expansions, they can be, and often are, modified in character, in direction of growth, in position and in area by convention and directive effort—legislative, administrative or municipal. It is obviously an enormous relief to streets and means of transit in Central London, when the outer suburbs become, as far as possible, self-sufficient. Many metropolitan suburbs are making great strides in that direction. Such decentralisation affects passenger traffic mainly. Can nothing be done in the same direction so as to reduce the amount of goods traffic and the number of commercial vehicles passing through the congested parts of London? Emphatically yes, if only factories can be removed from the central area, not necessarily to the outermost suburbs, but to positions which, according to the class of factory, will entail the least use of public streets.

The stress on all sides of financial stringency makes it imperative to examine whether any cheaper alternative exists to the construction of new, or the widening of existing streets in districts where additional street accommodation is required. It may well be that heroic methods are justified, indeed overdue. Lord Montagu (member of Council), with his characteristic bold foresight, proposed in *The Times* of August 21st, 1924, the construction of "double-deck" streets. I personally think we shall be driven to that expedient, and at no distant date. If streets cannot be extended laterally, they must be extended upwards. Surely to see "London walking on stilts," as *The Times* leader-writer happily phrased it, would be preferable to seeing London unable to walk at all. The steady increase of vehicular traffic which I have already described indicates that this latter condition is no mere morbid apprehension. The Royal Commission, which, it may be explained, was advised by distinguished engineers considered that "two-storey" streets were practicable, but forebore to recommend them, as it desired not to detract from the eminent desirability of the new streets and street improvements, which it did recommend, being constructed on the surface.

And still other expedients, in substitution for constructing new, or widening existing streets, must be sought. If goods for distribution to or transmission from premises in central London cannot be transported on the surfaces of streets, is it not possible for them to be conveyed in deep tunnels beneath the surface? That system has worked in Chicago, why not in London? The Post Office Tube Railway with driverless trains for mail transport, expected to be opened in two years time between Paddington Station and the Eastern District Post Office, in Whitechapel, and connecting *en route* with the Western and Western Central District Post Offices, Mount Pleasant, General Post Office, and Liverpool-street Station, will show what this method can in practice achieve. Personally, I am of opinion that Mr. Gattie's well-known scheme also demands the close attention of the new committee—in fact, much more careful consideration than it has ever yet received. No vested interests should be allowed to stand in the way of such a proposal if it is reasonably practicable, commercially satisfactory and likely to relieve crowded streets in central London.

Bridges.

The time has come when not merely the demands of cross-river street traffic, but the structural condition of some bridges, make immediately imperative the consideration of the whole question of London's bridges across the Thames. No one can deny that London enjoys a smaller measure of bridge facilities for cross-river street traffic than Paris, Berlin or Vienna. The distance between Blackfriars Bridge and Waterloo Bridge is 960 yards; between the latter bridge and Westminster Bridge, 1063 yards; and between Westminster Bridge and Vauxhall Bridge, 1699 yards. The reconstruction of Lambeth Bridge will reduce this last gap. But across the river Seine, and serving the central districts of Paris, there are, in a length of river of about 3800 yards, or almost the same distance as between Blackfriars and Vauxhall bridges, no less than 12 bridges, with an average distance between them of 345 yards, the maximum distance being about 492 yards. In Vienna there are in a length of about 5740 yards eight bridges across the Danube Canal, which intersects the city, the average distance between them being 819 yards. In Berlin there are 26 bridges across the river Spree in a length of 10,936 yards, the average distance between them being 437 yards. Not only is there an insufficiency of bridges in the central area of London, but certain of the bridges do not point in the right direction for important streams of traffic. Notably is this the case on the Middlesex side between Westminster Bridge and Blackfriars Bridge. And other important bridges, *e.g.*, Chelsea, Albert and Hammersmith, are subject to weight restrictions.

If the new committee could induce the London County Council and the Corporation of London to appoint a joint committee to go into the whole question of cross-river street traffic, and report to the new committee their recommendations, it would be a good beginning of a great public work. Such a project has for some time been on the tapis.

Railways and Tramways.

By what means is suburban traffic in any organised scheme of London transport to be conveyed? That question really turns on whether tubes or main-line railways are to cater for what is called the middle suburban zone, which represents a large and growing area in Greater London. Unless a district in that zone is actually traversed by, or within a distance of not more than one half mile from the main line railway, it can only be served by a branch line connecting with an already crowded main line leading into an equally crowded terminal station. Such a result leads to the conclusion that the class of transit facilities required to develop, and later to serve, the middle suburban zone can best be provided by tube railways. The new committee is faced with the immediate difficulty of how the construction of new tubes is to be assured.

What place should be assigned to tramways in London's future scheme of organised locomotion? Were we starting afresh in London, and not biassed by any predilection for either public or private enterprise, would we with our present experience, after all essential factors are considered—capital cost, maintenance, working expenses, effect on other road traffic—be right to adopt tramways for the conveyance of surface street traffic in London? Will not experience since the war cause us to hesitate before we answer in the affirmative? The evidence suggests that under present-day conditions, with fares on a scale in reasonable relation to the current standard of wages and the cost of living, tramways are exhibiting indications that cannot be neglected of their inability to remain economic self-supporting agencies of transit. In connection with the tramway undertakings, company and local authority, in the London traffic area, all of which are paralleled by motor omnibus routes, the new committee will have to explore these very difficult economic questions. Can the traffic be properly carried by one form of transit, the omnibus? In that event is there any economic argument for continuing tramways in the London traffic area? As I have already said, I am confining myself to the technical and economic aspects of the case, and am declining to enter into municipal politics. If tramways are to be continued, then two things are essential: many overdue improvements must be provided, though I can make no suggestion where the money for them is to be derived; the overlapping services of tramcars and omnibuses must be worked in close co-operation and no longer in competition.

Omnibuses.

To endeavour to reduce the perplexing confusion which at present surrounds the omnibus position in the London traffic area to some settled order will inevitably be an early responsibility of the new committee. It is surely time to recognise the importance of the part played by omnibuses in carrying metropolitan street traffic, and to realise that the interests of the travelling public wholly preclude any omnibus owner from being allowed to stake out a claim exactly where he pleases, and working it on his own, in pioneer exclusiveness, just as long as it yields him gold. If the mistakes and errors of the past history of London traffic teach nothing else, they teach this lesson with cogent force—such a course is absolutely destructive of London's welfare.

Co-ordination.

First, last, and all the time, the new committee's policy must, with implacable determination, be inflexibly directed to secure an ever increasing measure of co-ordination of the agencies of transit in the London traffic area. Co-ordination is not a mere portentous phrase to toy with, nor is it evidenced by a fussy interference in the management of transport undertakings. It means a constant and deliberate endeavour to mould the projection and operation of the various transport undertakings in the London traffic area to the end that their combined services may produce, so far as can possibly be contrived, a maximum measure of facilities. That measure, while so many separate transport undertakings are in existence, must be somewhat of an abstraction; an ideal to be pursued, an end not in practice to be fully realised. But it is a goal, towards which every advance will bring increases, vastly more than proportionate, in public benefits and convenience.

Obituary.

EDOUARD G. DEVILLE.

The death is reported of Dr. Edouard G. Deville, I.S.O., M.E.I.C., Director-General of Surveys in the Canadian Department of the Interior, as having taken place on September 21st, after a lengthy illness.

Dr. Deville, who was in his seventy-fourth year, was born at Château du Loire, France, and after a brilliant career in the French Navy, where he was in charge of extensive hydrographic surveys, went to Canada in 1874. He was for some time engaged in survey work for the Quebec Government and afterwards joined the survey staff of the Dominion, succeeding Lindsay Russell as Surveyor-General. He held that position for thirty-one years until two years ago, when he was made Director-General of Surveys. He established the system of Dominion Lands Survey, which is noted for its excellence, and represented Canada on many international committees, on which his scientific attainments rendered his work of high value.

Dr. Deville was the author of several scientific works, including "Astronomic and Geodetic Calculations" and "Photographic Surveying," and was a regular contributor to the "Proceedings" of the Royal Society of Canada. In recognition of his distinguished public services the King created him a Companion of the Imperial Service Order, and he received from the University of Toronto the degree of Doctor of Laws. Two years ago he was made an honorary member of the Engineering Institute of Canada.

ARTHUR WILLIAM GLOVER.

We regret to have to record the death of Mr. Arthur William Glover, M.I. Mech. E., which occurred on Monday, September 29th, at his home, "Riversdale," Pool, Yorkshire, in his sixty-third year.

Mr. Glover was the principal of the firm of M. Glover and Co., sawmill engineers, of Holbeck-lane, Leeds, which was founded by his father, the late Mr. Matthew Glover, nearly seventy years ago, and continued by the sons, Mr. A. W. Glover and Mr. M. H. Glover, an elder brother, who later relinquished his interests in M. Glover and Co. to join his eldest brother, Mr. C. H. Glover, in the timber business of the late firm, C. H. Glover and Co., Limited, Hatcham Sawmills, Old Kent-road, S.E.

Mr. A. W. Glover's inventive ability, pronounced activity and business acumen resulted in the considerable development of M. Glover and Co. He was well known in the engineering and timber trades and a great traveller, having during the course of his business career visited several times practically every corner of the United Kingdom besides most European countries and America. As an employer the length of service of the firm's staff proves the esteem and affection in which he was held by those in its service. Mr. Glover was the sole proprietor of Burys Earthenware Pottery Brick and Tile Works, Sutton, Macclesfield, which was established over one hundred years ago and was previously owned by Mrs. Glover's family, and also of the A1 Blazer Firewood and Firelighter Company, of Leeds.

According to Mr. J. A. Vaughan the Transvaal system of passing ore from higher to lower levels through chutes is not to be recommended, as it gives rise to much dust. In theory it is attractive, from the point of view of economy, but it is uncertain in efficiency, for falls of roof and other mining mishaps lead to choking of the passages and interference with the regular output of the mine. A proper railed track, served by winches if necessary, would be preferable for the lowering of the rock. The winding cost in vertical shafts of about 4000ft. depth may be taken at about 9d. per ton. The cost of shaft maintenance varies from 1d. to 8d. per ton of rock hoisted. Here again, the subsidiary inclines are the expensive shafts to maintain. So far as the lowest costs are concerned, these only apply to shafts newly put into commission, where, naturally, necessary repairs are very slight. In modern vertical shafts of about 4000ft. depth, 2d. per ton appears to be a reasonable estimate of the cost of shaft maintenance.

Post Office Tube Railway.

Although two more years must elapse before the Post Office Tube Railway is in actual operation for the carriage of mail matter between district post and parcel offices in London and some of the principal railway stations, the final stage of the work on the first section of the railway has now been entered upon. The contract which has just been placed with the English Electric Company includes the supply of the equipment for automatic electrical operation and the rolling stock. The railway is interesting as being the first example in the world of a system, used for commercial services, being operated without drivers or other attendants on the train.

The line in its present form, and in that which it will assume when various extensions are carried out, is shown on the accompanying plan. The completed portion extends from Paddington to Whitechapel, a distance of 6¼ miles. The main tunnelling operations, the whole of which were in the hands of Mr. H. H. Dalrymple Hay, were completed several years ago, but the interruption caused by the war and the high cost of engineering works in the early post-war period made it necessary to defer placing a contract for the equipment until the present time. No special difficulties were experienced, but it was found necessary to construct the line at various depths, ranging from about 28ft. to 80ft., beneath street level. The tunnels between stations are 9ft. in internal diameter, and they carry two tracks of 2ft. gauge.

The stations are designed with an island platform arranged in two sections between which will be constructed a control cabin and the lifts and conveying appliances — supplied by Spencer (Melksham) Limited—that have been specially designed to suit the varying classes of postal matter which have to be handled. This general design has been adopted in all cases, but the arrangements of the tracks and of the conveying appliances will be adjusted to suit the requirements at different points. There are stations at Paddington District Post Office, Western Parcels Office, Western District Post Office, West Central District Post Office, Mount Pleasant, King Edward Building (serving the General Post Office), Liverpool-street, and Eastern District Office (Whitechapel). At the big junction stations shown on the plan—Mount Pleasant, King Edward Building, and West Central District Office—provision has been made to facilitate possible extensions by loop line or shuttle services to Euston, King's Cross, St. Pancras, Northern District Post Office, South-Western District Post Office, South-Eastern District Post Office, and Waterloo, Cannon-street and London Bridge stations. These extensions will involve two tunnels under the river Thames. At the terminal stations of the present line, loops have been constructed to enable trains to run round without reversing, and reversing operations will only be necessary when the trains go into siding. It has not yet been decided whether the power for operating the railway shall be supplied from an outside source or drawn from the Post Office power station.

At the present time the Post Office Engineering Department is not desirous of publishing complete technical details of the scheme of operation, but having regard to the interest which has been aroused by the placing of a contract for the equipment, the following general details may prove of interest. The power plant will supply three-phase electrical current at a pressure of 6300 volts between phases of 50 periods per second to sub-stations at Mount Pleasant and King Edward Building. Current will be transmitted from these stations to railway sub-stations at Western Parcels Office and Liverpool-street, and these two stations, as well as Mount Pleasant, will be equipped with plant for converting the supply to direct current at 440 volts, which, in addition to operating the trains, will work the lifts and conveyors and be used for ventilation and lighting requirements. A single conductor rail will be laid between the track rails, which will be utilised for the return. The running rails will be bonded to the tunnel lining, whilst a negative feeder will assist in keeping down the voltage drop on the return circuit. The conductor rails will be divided into sections, and will be supplied at two voltages designed to give running speeds of about 8 miles per hour and 35 miles per hour.

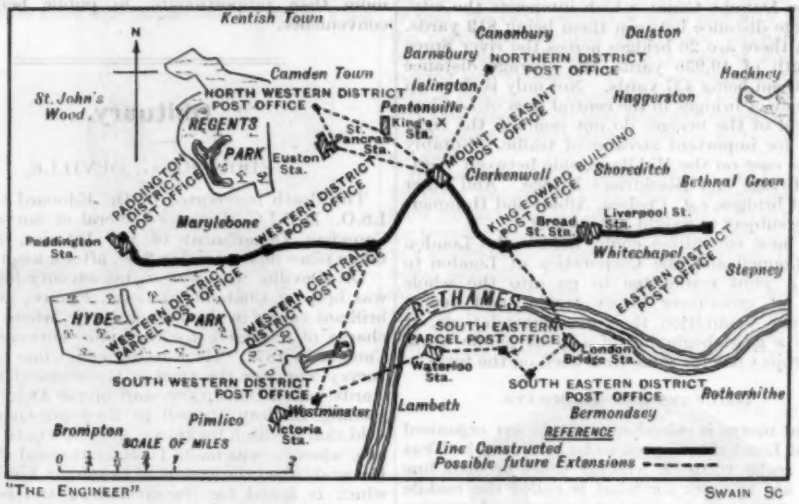
The sectionalising of the track will be effected by the train itself, which will operate a simple form of switch. Between stations current will be supplied to the conductor rail at such a pressure as to give the wagons a speed of about 35 miles per hour. On approaching a station the train, if required to stop, will pass on to a braking section, which is normally dead, and then on to sections in which the pressure on the conductor rail current is reduced to give a speed of about 8 miles per hour, and, finally, on to a dead section within the station, when the brakes will be automatically applied and the train be brought to rest. Retardation and acceleration will be assisted by the gradients in the vicinity of the station. Through trains, on approaching a station, will pass over a section of line on which the speed will be reduced to about 8 miles, and will, as they pass through the station, enter a high-speed section, on which the speed will be increased to 35 miles per hour. A train which has been brought to rest at a station will be despatched by making alive the section of the conductor rail on which it is standing. Trains will be moved into and out of sidings and from one platform section to another in a similar manner, but whereas for restarting a train current will be supplied at 440 volts, siding and platform movements will be operated by current at a lower pressure. The train brakes will be automatically taken off on the application of current, and each wagon will be provided with means for holding the brakes off, when desired, without making alive the conductor rail, so that wagons can be moved by hand for coupling or uncoupling operations.

As already stated, the presence of drivers on the trains will be dispensed with, control of the traffic being exercised from control cabins at the stations. The platform sections of the conductor rails at the stations will be made dead by the switch man when desired, and each main section will always be made dead automatically as the train leaves it and alive again on the train entering the next section but one, an arrangement which will provide for a dead section between following trains. The control of a train as it comes to rest at a platform or passes through a station will not require the continuous attention of the switch man.

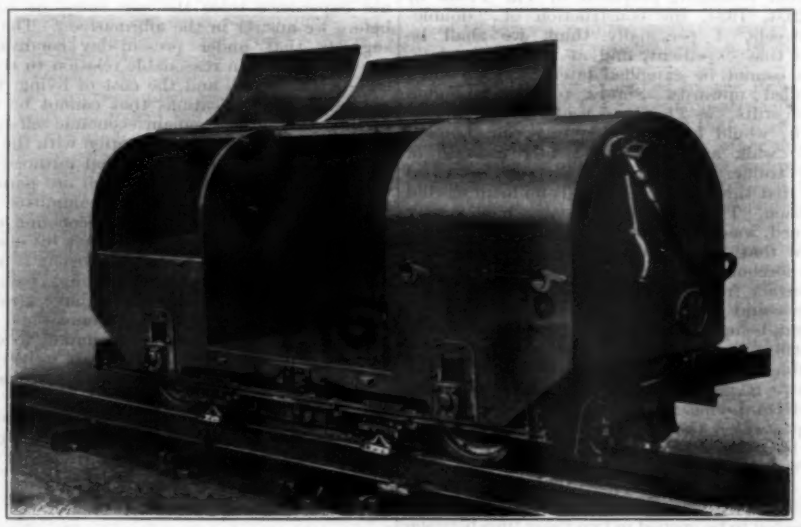
The positions in the tunnels and the destination of each train will be notified to the switch man on an illuminated diagram in the control cabin. Having this information, he will arrange the points for the particular route desired, and energise certain sections of the conductor rails with current at the appropriate pressure. The wagon or train will then either come to rest at the station or will run through the station without further attention. The operation of the points will be interlocked with the application of the current, and there will be a complete interlocking arrangement between the different routes. It will be seen therefore that the system of control will be generally similar to the power-operated point and signal systems in use on certain railways, but with the signal element replaced by the application of current for the track.

In inviting tenders for the equipment, the Post Office Engineering Department, although specifying in detail the requirements which have to be met, allowed a certain measure of latitude to tendering firms to suggest modifications of the system, but it is understood that the equipment to be supplied is that which, as a result of a good deal of experimental work, has been developed by the Post Office engineers. An experimental track was laid down at Woolwich. It reproduced the gradients of the actual line, the maximum of which is 1 in 20 adjacent to station summits, and the radius of curves, the sharpest of which on the loops of the line is 60ft. The experimental wagon—which is illustrated herewith—represents the type which has been adopted for the postal trains. The rolling stock will be comprised of ninety steel cars of this type, each having a carrying capacity of 10 cwt., which will give the line a total traffic capacity of 45 tons per hour in each direction, although this may be limited by the quantity of matter which can be handled at the stations in a given time. The wagons will be of the four-wheel type, the two axles being motor driven through spur reduction gearing. The wheel base of the wagons will be 7ft. 3in.; overall length, 13ft. 5in.; height, 5ft.; and width, 2ft. 10in. Each wagon will be fitted with two direct-current series-wound motors connected for permanent parallel operation, each with a resistance in circuit. A car shed will be provided at Mount Pleasant.

At all stations the postal matter will be handled by mechanical power. Spiral shoots will be provided for downward matter at each station and lifts for upward traffic, and at the larger stations the plans for handling traffic include the installation underneath the platforms of electrically operated conveyor bands, which will deliver to bucket elevators. When the line is brought into operation it will not only effect a considerable speeding up of mail traffic throughout the London area, but by the removal of the traffic underground relieve the streets of a large number of Post Office vehicles, and thereby assist in the alleviation of the street congestion problem.



ROUTE OF THE POST OFFICE TUBE RAILWAY



G.P.O. TUBE RAILWAY MOTOR WAGON

On the 29th ult. the 3.45 p.m. Swindon to Paddington ran the 77¼ miles in 71 minutes, or at an average speed of 65.3 miles per hour. The booked time is 75 minutes, or 61.8 miles per hour. The engine was No. 4000 "North Star."

British Wire-drawing and Wire-working Machinery.

No. XII.—ELECTRIC CABLE MAKING.*

The Charlton works of Johnson and Phillips provide an excellent opportunity for studying the process and machinery for manufacturing electric cables, as not only does the firm make cables on a large scale, but the necessary machinery is all made there, and complete plants are supplied for other cable makers. The designers in the drawing-office consequently have a good opportunity for studying the effects of any innovations they may produce, and improvements can readily be made in light of the experience thus gained.

The first step in cable making is to wind the wire on to bobbins for insertion in the stranding machine. This operation is sometimes done by hand, but the automatic winding machine—shown in Fig. 87—saves a considerable amount of labour in the case of comparatively light wires. It is, however, noteworthy that with a simple belt-driven spindle, for mounting the bobbin on, and a piece of rag in his hand, to guide the wire, a lad can get very nearly as much wire on to a bobbin as is the case when the automatic winder accurately lays all the turns as close together as is possible.

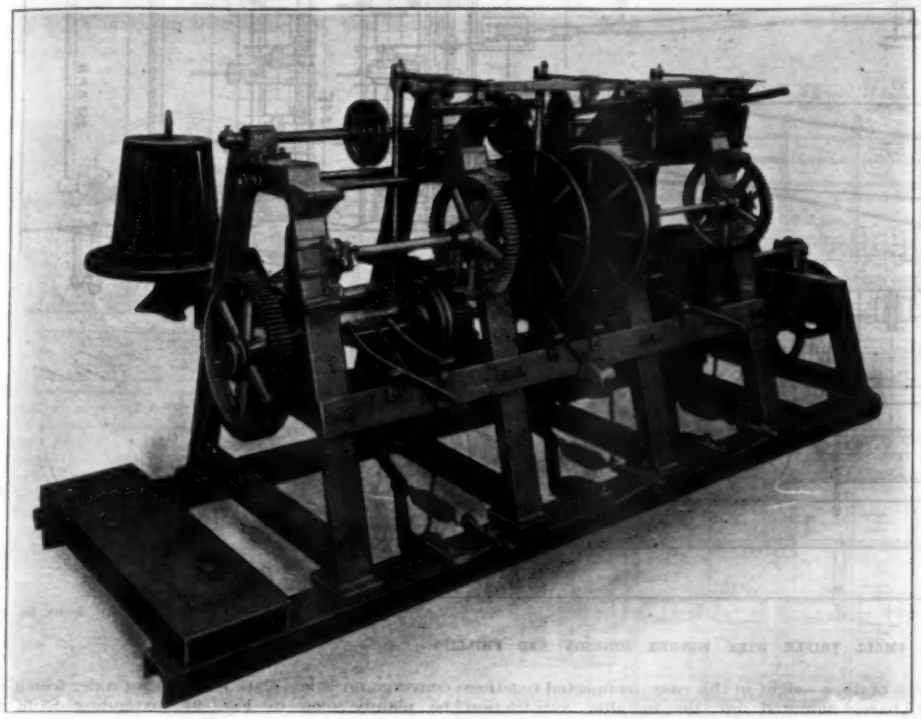


FIG. 87—HIGH-SPEED TRIPLE AUTOMATIC WIRE WINDER—JOHNSON AND PHILLIPS

In hand winding the wire is taken from the coil on a swift, round a measuring pulley, generally two yards in circumference, and then through the attendant's hand to the bobbin. A simple brake is provided so that the swift can be stopped from overrunning at the end of a wind, and a revolution counter on the measuring wheel is used to show the amount of wire put upon the bobbin.

The automatic machine—illustrated by Fig. 87—is arranged to accommodate three bobbins up to 20in. in diameter by 10in. wide between the flanges. It is really three separate machines grouped together in a frame and driven independently off one shaft. This shaft can be seen extending from the left of the machine, where it carries a gear wheel for meshing with the pinion of an electric motor fixed on the base below. There are three gear wheels on this shaft for driving the bobbin spindles. The connection between the shaft and the wheels is made by means of clutches with hand levers above, so that the bobbins can be started separately. All the gearing has machine-cut teeth.

The bobbin spindles, it will be seen, are mounted in bearings, with hinged keeps clamped by swing bolts and butterfly nuts, so that they may be quickly taken out for the bobbin to be threaded into place. A driver, with a projecting pin, keyed to the spindle engages with a hole in the side of the bobbin flange. The speed of the bobbin is approximately 250 revolutions per minute.

The wire is led on to the bobbins over the grooved pulleys seen at the top of the machine, and these pulleys are traversed backwards and forwards for flaking the wire on to the bobbin. The traversing mechanism is at the back end of the machine, and comprises a right and left-hand screw, which is shown in the elevation—Fig. 88. This screw is driven from the main shaft through a set of change wheels, so that its speed can be altered to suit the wire being wound. The nut on this screw engages with the bottom end of a vertical rocking lever, the top end of which is connected with the shaft carrying the grooved pulleys. By altering the position of the lever fulcrum the length of stroke can be adjusted to suit the width of the bobbins being wound.

At the back of the machine there are the swifts on which the coils of wire to be wound on to the bobbins are placed. One of these swifts is plainly shown in the engraving—Fig. 87. The arrangements made for stopping the machine in the case of any untoward event are best illustrated by the line drawing—Fig. 88—from which it will be seen that the coils of wire are led from their respective swifts, A, B and C, through die-holes D, round the pulleys E and F, up to the roller G and on to the bobbin H. Supported by the wire and resting on top of it is a small roller J carried off an arm fulcrumed at K, and in the event of a wire breaking this allows the small roller J to drop down. The roller is connected by a piece of steel cable to a lever L, which is fulcrumed at M, and the movement of this lever releases a spring plunger. At the moment the plunger falls the clutch lever N is pulled over by means of a tension spring—being held in position normally by the spring plunger above referred to—and throws the clutch out of gear, thus stopping the bobbin from being driven. It should be here noted that when the machine is stopped the brake comes

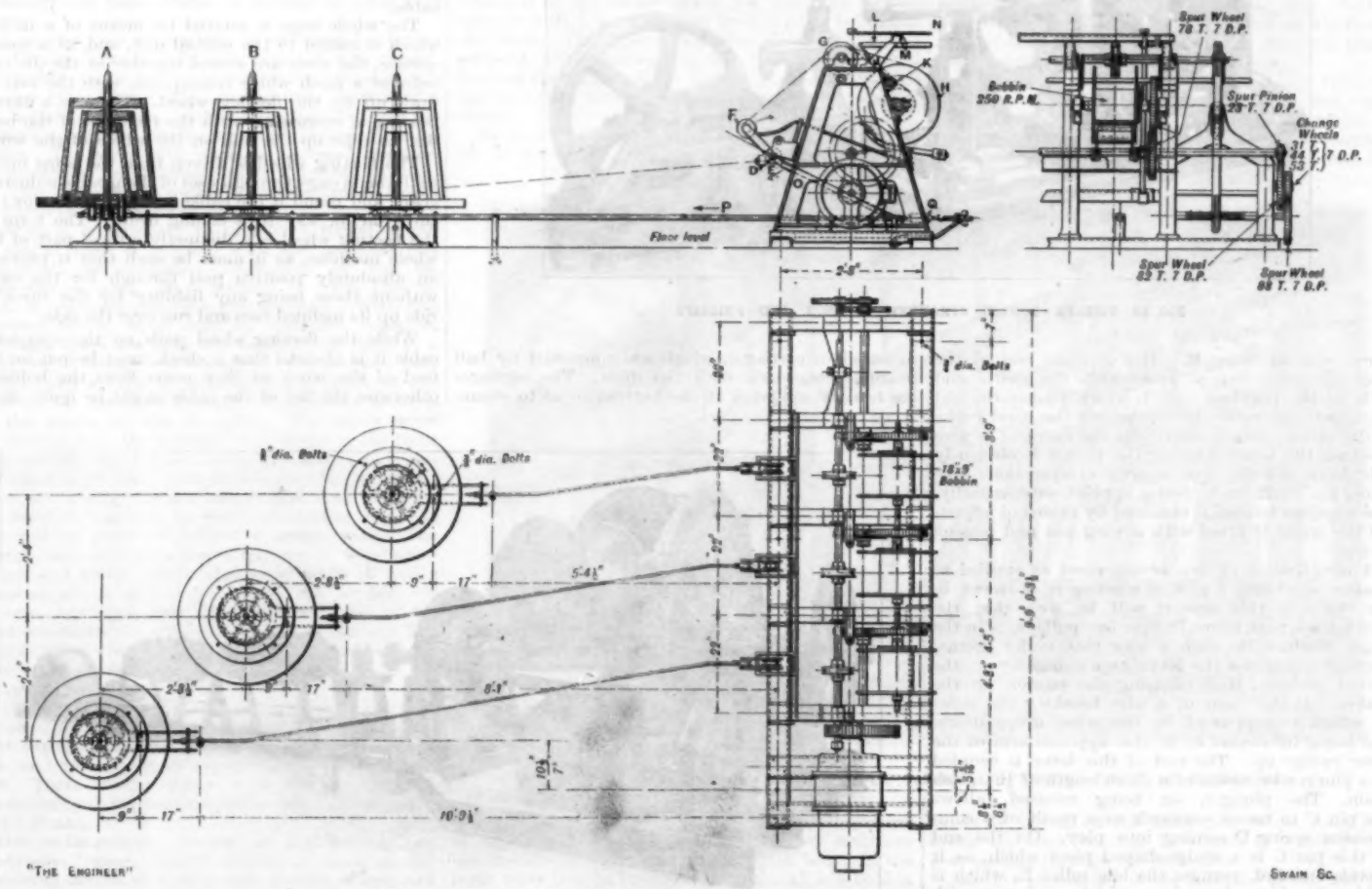


FIG. 88—LARGE TRIPLE WIRE WINDING MACHINE—JOHNSON AND PHILLIPS

* No. XI. appeared October 3rd.

automatically on to the swifts. This action is accomplished by means of the arm which carries the pulley F fulcrumed off the same centre as the pulley E. In other words, when the machine is running the tension in the wire is such that it causes the lever carrying the pulley F to swing up, as shown by the arrow, and in doing this the opposite end of the lever obviously swings in towards the swifts and pulls on the coupling rod O, which pushes the rod P towards the swifts, thus releasing the band brake of the corresponding swift. In the event of a wire breaking the lever carrying the pulley F obviously falls down and the reverse cycle of operations take place, the swift brake being applied automatically. The requisite tension is obtained by means of adjusting the screw Q fitted with a wing nut and tension spring.

A modification of this arrangement as applied to smaller machines for wire winding is as shown in Fig. 89. In this case it will be seen that the wire takes a path from the over two pulleys, as in the larger machine, in such a way that under normal running conditions the lever arm swings up to the dotted position, thus releasing the tension on the brakes. In the event of a wire breaking the roller A, which is supported by the wire, drops down, and being fulcrumed at B, the opposite arm of the lever swings up. The end of this lever is coupled to a plunger by means of a short length of ¼in. pitch chain. The plunger, on being released, allows the pin C to travel outwards as a result of a compression spring D coming into play. On the end of this pin C is a wedge-shaped piece which, as it travels outward, permits the idle roller E, which is rubber faced, to drop down and lose contact with the friction driving pulleys F and also the friction disc G on the bobbin spindle. At the same time, as explained for the larger machine, the swift brakes come into operation simultaneously.

The first stage in the process of laying the wires together to form a cable is carried out in the machine illustrated by Fig. 94, page 410—which winds together seven strands—that is to say, six strands round a central wire.

The machine comprises a long cage built up of a series of discs—eight in this case—connected together by bars, mounted on non-metallic anti-friction rollers. Inside the cage the bobbins of wire are mounted in carriages, which are supported by ball bearings concentric with the discs. The carriages are heavily weighted at the bottom so as to ensure that they will remain stationary while the cage is rotated. The wire coming from each bobbin is led through guides and then along the bars of the cage, which are provided with fairleads for the purpose, to the disc at the delivery end of the cage. The wires emerge there at the periphery of the disc and converge on a lay plate fixed on an axle, which can be plainly seen in Fig. 94, extending from the front of the front disc. The central wire comes off the first bobbin and goes directly through the centre of the disc. The wires then go through a die to the fleeting, or drawing off, wheel at the end of the machine. The die is mounted on a bracket which can be adjusted longitudinally to suit the angle of twist, or lay, of the strands, and is itself split so that it can be put in place over the cable. The die is bored out to the exact diameter of the finished cable.

The whole cage is rotated by means of a motor, which is geared to the central disc, and, as a consequence, the wires are wound together at the die in a helix of a pitch which corresponds with the rate of draw off by the fleeting wheel. There is a thrust bearing in connection with the trunnion of the back disc to take up the pull on the whole of the wires.

The fleeting wheel is driven from the same motor as the main cage, through a set of changeable reduction gears, and round it the cable is taken for one or two turns on its way to a coiling drum. The form of the fleeting wheel is a distinctly critical part of the whole machine, as it must be such that it provides an absolutely positive pull through for the cable without there being any liability for the turns to ride up its inclined face and run over the side.

While the fleeting wheel pulls on the completed cable it is obvious that a check must be put on the feed of the wires as they come from the bobbins, otherwise the lay of the cable might be quite slack. To effect this purpose a piece of cord is lapped round a brake drum on each bobbin spindle, and one end of the cord is attached to a lever carrying a guide

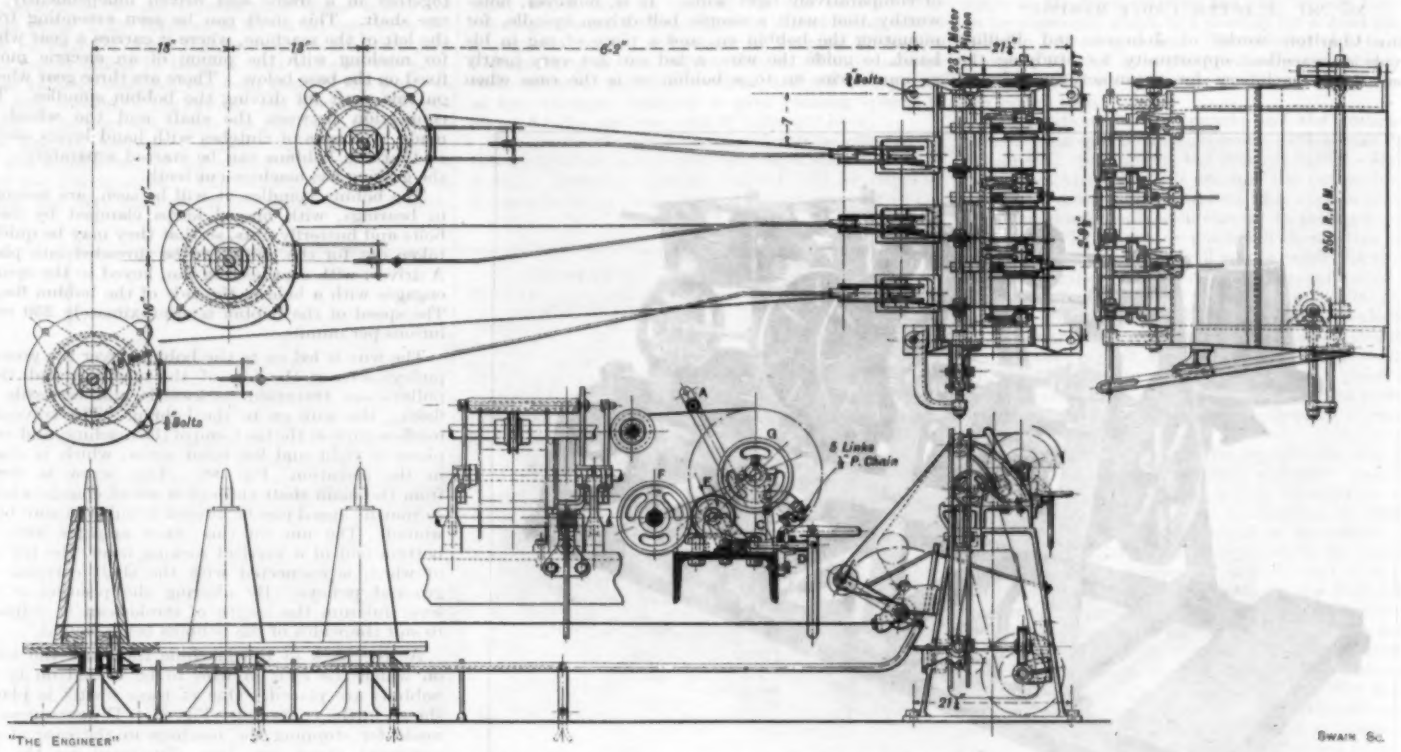


FIG. 89—SMALL TRIPLE WIRE WINDER—JOHNSON AND PHILLIPS

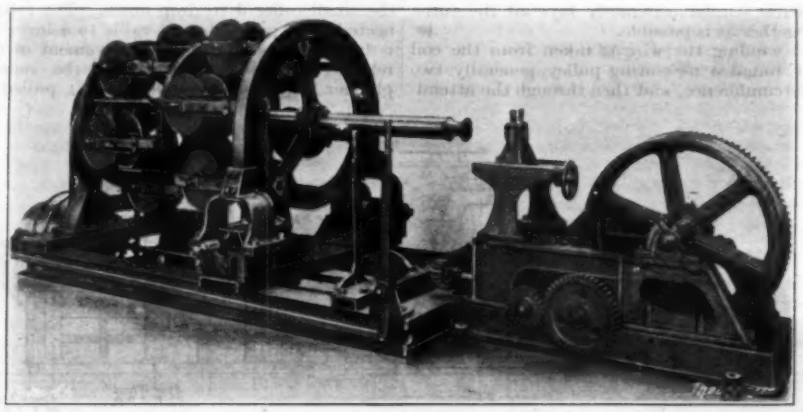


FIG. 90—TWELVE-BOBBIN STRANDER—JOHNSON AND PHILLIPS

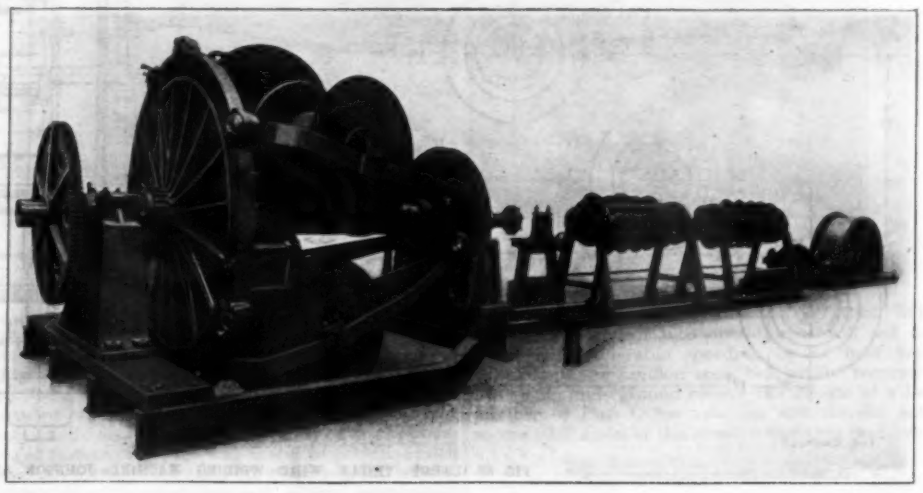


FIG. 91—THREE OR FOUR-BOBBIN CLOSING MACHINE—JOHNSON AND PHILLIPS

for the wire in question. The arrangement is such that if the wire tends to run slack the brake is put on to increase the tension and *vice versâ*. By the same rule when the machine is stopped the brake is put on hard and stops the bobbin over-running. A special automatic device is sometimes added for stopping the whole machine in the event of any of the wires breaking accidentally.

The cages of these machines run at a speed of about 1000 revolutions per minute, and it is really astonishing, in view of the number of separate parts which go to make up their structure, how steadily they run. It is, however, obvious that they need a really solid foundation to keep all the bearings in line, although the main frame is formed of good stiff joists.

A similar type of machine is also used for laying up 19-wire strands. In this case a 7-wire strand, previously made on a corresponding machine, is carried by a large bobbin in the front section of a 13 bobbin machine, with twelve smaller bobbins behind it, so that twelve wires are stranded round seven. The use of such machines becomes, however, commercially impracticable after a bobbin of 10in. to 12in. is reached owing to the extreme length to which the machine extends.

When it is necessary to produce a longer length of strand than is possible with the machine just described, the machine — illustrated by Fig. 96, page 410—is used. In it bobbins of from 12in. to 24in. in diameter can be accommodated. With this machine seven wires can be stranded together, although there are only six bobbins, as there is a clear way through the mandrel. The seventh wire is led from a bobbin, mounted on a stand at the back of the machine, straight through the mandrel to the centre of the die plate. The other wires go directly from the bobbins to openings in the front disc, which are bushed with bell-mouthed, case-hardened steel dies, and thence to the lay plate. It is noteworthy in this connection that although the machine has only to deal with copper wire, the dies and lay plate are subject to severe wear. The copper cuts very perceptible grooves in the harder metal, and many efforts have been made to find a material which will stand up to the service. It appears, however, that case-hardened steel is the most satisfactory for both dies and lay plates. The contour of the bell mouths has naturally some influence on the wear, and care is taken to make the curvature as easy as possible.

It will be noticed that each of the bobbins is mounted in a cage pivoted in the main rotating frame. Each cage has a spindle that projects through the rear disc, and on the end of this spindle there is a crank arm. These cranks engage with another disc, set excentrically to the mandrel to the extent of the throw of the cranks.

This arrangement, known as a "floating" or "detorsion" gear, is very similar to that of the feathering action of a steamer's paddle wheel, and insures that the axes of the bobbins will retain a horizontal direction as they rotate bodily round the mandrel. When desired the machine may, however, be arranged to run with the bobbins "fixed" or radial to the central axis by the simple process of removing the excentric ring and placing it centrally into lipped joggles on the heads of the cast steel cranks.

The die bracket is adjustable and the draw gear is fitted with a complete set of machine cut spur change wheels for varying the length of lay.

The weight of the revolving cage is carried at the back by a white metal lined bearing, and at the front on two adjustable anti-friction rollers arranged beneath the front disc. The machine illustrated is intended for belt driving, but it can, of course, be arranged to be driven directly by a motor. In connection with the drive there is a powerful brake, so that the machine can be stopped quickly in case of necessity.

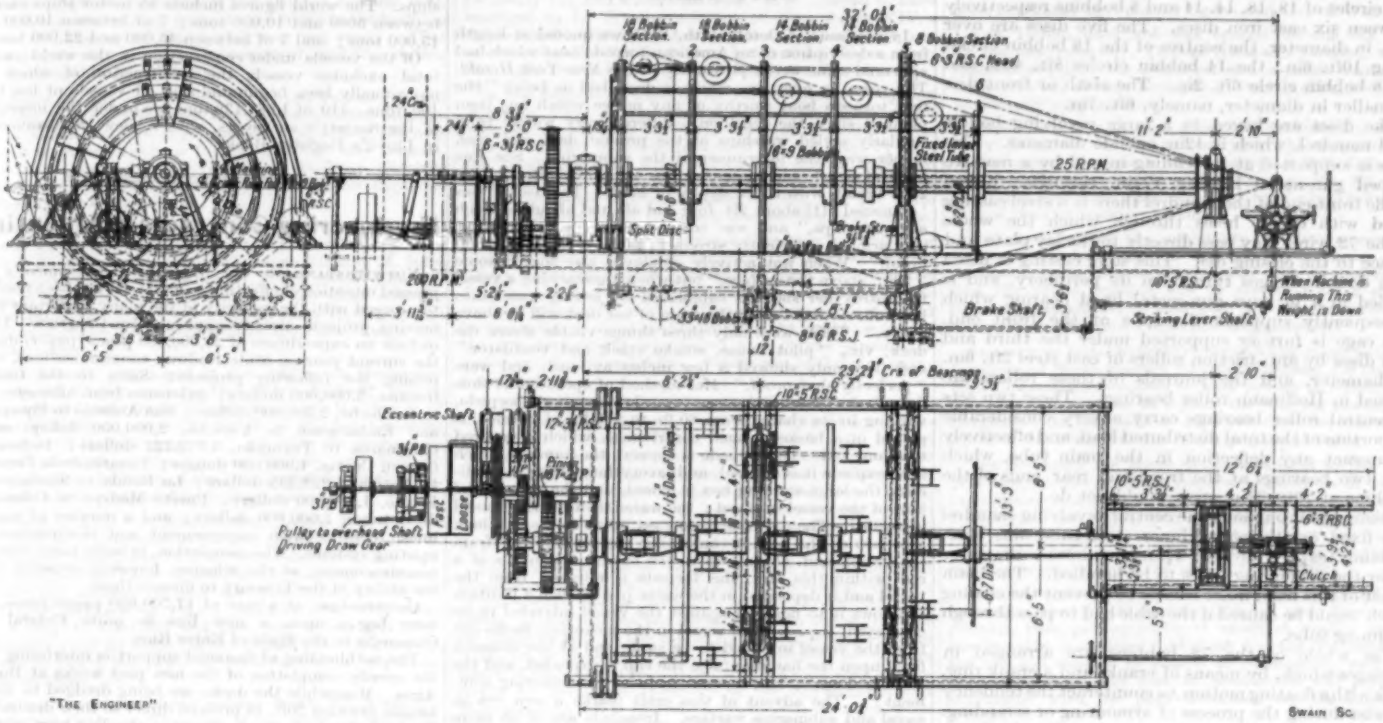


FIG. 93—SEVENTY-TWO-BOBBIN WIRE ARMOURING MACHINE—JOHNSON AND PHILLIPS

Fig. 90 represents a machine of the same type as that just described, but with twelve bobbins, arranged in two circles of six, for laying up 19-wire strands with 7 wires coming from a fixed bobbin at the back. This illustration also shows the means adopted for adjusting the anti-friction rollers and keeping the cage in line. It will be noticed that the cage is driven from the shaft below through a silent chain.

Another machine illustrated on page 410—see Fig. 95—is known as a double-tandem strander, and can be used for laying together several combinations of wires. It really comprises the two machines last described grouped together on one bed. In the front there is a 12 bobbin strander, with a 6 bobbin machine behind, and at the back there is accommodation for a drum of ready-layed strand. Thus eighteen wires can be put on at one time, and by laying them over a 19-wire core 37-wire strands can be made. The two sections are, however, independent, and can be used separately for laying up smaller strands. There is one driving pulley, but between the two machines there is a set of gear wheels giving a clutch action and reversal, so that the two sets of wires can be laid in opposite directions if that be desired. The relative speeds of the two machines can also be varied by the gears.

A still more elaborate development of the same idea is represented in Fig. 98, page 410, which shows a triple tandem stranding machine having twelve, eighteen and twenty-four bobbins in the several sections.

For exceptionally large cables the strands already layed up are put on the bobbins of the machine illustrated in Fig. 91 and are closed together. The essential principle of the closing machine is the same as that of the stranding machine, but it is naturally of heavier construction. The floating gear for the bobbin cages is, however, of a different design, and takes the form of the sun and planet wheels seen inside the front disc.

It will be noticed that the sun wheel is of twice the diameter of the planet wheels, which, at first sight, makes it appear that the bobbin cages would be rotated. The sun wheel, however, is not stationary. It is mounted on a sleeve on the mandrel, and this sleeve is driven off the fixed gear wheel, seen just inside the back bearing, by means of a two-to-one gear passing through the back disc.

FIG. 94—FRONT END OF MACHINE WITH TAPING AND SERVING UNITS IN FOREGROUND

Another peculiarity of the machine is the inclination of the bobbin carriages towards the layhead, so that the strands have a very direct and easy passage towards the closing point, and unnecessary bending is avoided.

As shown in the illustration, the machine is equipped with four bobbins, but the end plates have a second set of journals for the cages, so placed that three bobbins can be used instead. The capacity of the

machine may be gauged by the fact that it will accommodate bobbins up to 6ft. in diameter. The apparatus seen in front of the closing machine is used for lapping the cable with paper for insulating purposes.

A very fine example of large cable making machinery, which has recently been supplied for the Woolwich works of Siemens Bros., by Johnson and Phillips, is illustrated by the line drawing—Fig. 92—and the half-tone engravings—Figs. 97 and 99, page 40, and in Fig. 93. It is intended primarily for the armouring of very large cables and consists of a 72 bobbin section having the spools arranged in five circles of 18, 18, 14, 14 and 8 bobbins respectively between six cast iron discs. The five discs are over 11ft. in diameter, the centres of the 18 bobbin circles being 10ft. 6in., the 14 bobbin circles 8ft. 4in., and the 8 bobbin circle 6ft. 2in. The sixth or front disc is smaller in diameter, namely, 6ft. 7in.

The discs are keyed to a large revolving hollow steel mandrel, which is 12in. outside diameter. This tube is supported at its leading in end by a massive capped gun-metal bearing 17½in. through. Keyed to the front end of the mandrel there is a steel casting fitted with cored holes through which the whole of the 72 wires may pass directly to the lay plate and thence to the closing die. This steel casting is fitted with double flanges turned on its periphery, and is carried in a massive gun-metal lined bearing which consequently supports the tube at the front end. The cage is further supported under the third and fifth discs by anti-friction rollers of cast steel 2ft. 6in. in diameter, and the journals of these rollers are carried in Hoffmann roller bearings. These two sets of central roller bearings carry a very considerable proportion of the total distributed load, and effectively counteract any deflection in the main tube, which only two bearings at the front and rear ends of the machine at 29ft. 2½in. span would not do.

Running throughout the central revolving mandrel is a fixed or stationary inner steel tube 5in. bore, enabling cables up to 4¾in. maximum diameter under the armouring wires to be handled. The main object of this fixed inner tube is to prevent the chafing which would be caused if the cable had to pass through a running tube.

The whole of the 72 bobbins are arranged in carriages which, by means of cranks and a crank ring, work with a floating motion, to counteract the tendency to twist during the process of armouring or stranding. A very powerful band strap brake, Ferodo lined, is arranged to encircle the front disc and is operated by a hand lever from the lay head of the machine.

The machine, as will be seen, is driven from the rear end through a train of heavy machine cut spur wheels, the main drive being by belt, with fast and loose pulleys, 48in. in diameter by 12in. face, on a short countershaft at the rear of the machine. An additional interesting feature of this machine is the adoption of an auxiliary friction drive. A pulley 36in. in diameter by 4½in. face is keyed on to a shaft carrying a small wedge-shaped roller 10in. in diameter, mounted on an excentric sleeve and running at about 150 revolutions per minute. By the lifting of a weighted lever arm operated by a steel cable from the driving end of the machine, this excentric roller can be brought up to come into contact with the large grooved pulley 4ft. 4in. in diameter, which is keyed to the same shaft as the main fast and loose pulleys. Owing to the considerable purchase obtained through the spur reduction gear it is found that this friction device is so sensitive that it enables the driver to move the main cage with perfect ease a matter of an inch or two at a time, a particularly useful thing during the process of loading up. In addition, this same friction device facilitates the starting up of the machine.

An unusual feature of this particular machine is that it is designed to work when desired with 18 larger bobbins, namely, 33in. in diameter by 16in. wide. In order to do this, the second and fourth main cast iron discs of the machine are split so that they may be readily uncoupled and removed from the 12in. mandrel without dismantling the machine proper. Previous to this operation the four circles of smaller bobbins, namely, 18, 18, 14 and 14 respectively, must also be disconnected and removed, and in their place the 18 fliers or carriages for the larger bobbins put into position. It may here be mentioned that the whole of the carriages, both large and small, are fitted with loose trunnion ends to facilitate their being removed as required. The larger bobbins enable the machine to be used on a much heavier gauge of wire and a proportionally greater length without a joint. One of the engravings—Fig. 97—shows the machine with the 18 large bobbins in position. Fig. 99 is a view taken from the rear end of the machine, and illustrates the various taping, compounding and jute serving units for serving the cable before it enters into the armouring section; while Fig. 93 shows the front end of the machine and also illustrates the various serving units for serving the cable after it has been armoured. This same engraving shows the draw drum, which is 9ft. in diameter by 26in. wide, partially concealed in the pit. A full range of machine cut spur wheels is provided for varying the length of lay. Overhead will be seen what is known as the haul-off gear, the cable being led from the draw-drum up on to the large sheave which is fitted with jockey gear, and thence to the storage tanks. Above the armouring cage is a small travelling crane, carried on overhead runners, for the purpose of loading, &c. The whole machine constitutes one of the most up-to-date and largest machines of its kind in operation in this country, and has already been used with considerable success by Siemens Bros. on the manufacture of the new Anglo-Dutch submarine cable.

SIXTY YEARS AGO.

In our issue of October 7th, 1864, we quoted at length from a description of an American torpedo boat which had appeared some weeks previously in the *New York Herald*. The vessel in question, which is described as being "the first torpedo boat worthy of any notice which has been planned since the rebellion," differed very widely from similarly styled warships of the present day, and was, in her way, the forerunner of the submarine. She was built of wood, and measured, we are told, 75ft. long by 20ft. broad, with a 7ft. depth of hold. The deck "was 'crammed' (?) about 2ft. fore and aft and about as much athwart ships," and was covered with "a thickness of iron armour sufficiently strong to make it shot and shell proof." When not actively employed she floated some "20in. above the surface," but when approaching a vessel to destroy her she was submersed by letting water into her hull, so that "only the cram of her deck will be above water." There were only three things visible above the deck, viz., "pilot house, smoke stack and ventilator," and they only showed a few inches at most, and were "perfectly shot proof." Her method of operation is thus described: "As she advances towards her victim, a torpedo, varying in its charge from 60 lb. to 200 lb. of powder, is placed in a basket-formed contrivance, which is secured to a long rod. The torpedo is capped, the hammer which is to explode it is secured, and, everything being in readiness, the large working box is closed, and the gate at the bow of the vessel is raised; the water then rushes in until it is filled. The machine is now set in motion, and a long arm carries the basket containing the torpedo out from the vessel, and, closing up to the enemy, by means of a rod within this arm, the torpedo is released from the vessel and is deposited in the water just in such a position as allows it to float up against the vessel intended to be destroyed. . . . The vessel in the meantime backs out from the vessel intended to be sunk, and at the moment fixed upon the hammer falls, the cap is exploded, and the work is done." The account includes the following comment: "The advent of this craft marks a new era in naval and submarine warfare. Ironclads are of no more value than wooden vessels against one of these new vessels, without any guns or appearance of destruction." . . . The same issue also included a brief description of a new gas engine, or *gazomoteur*, the invention of a Monsieur Belon, which had been installed in a paper factory near Paris, and had been favourably reported upon by the Academy of Sciences. "It is stated," we reported, "that the machine possesses an economy equal to 60 or 70 per cent. It consists of three principal parts—an air pump, a smoke-consuming furnace, and a motive cylinder. The furnace, when the engine is at work, remains closed, unless at the orifice by which the air pump opens on it, and the one by which the heated air sets the cylinder in motion. It is so arranged that a quantity of combustible matter, equal to that which it consumes, falls constantly into it. A state of combustion is kept up by the air pump. Part of the air passing from this rushes into the furnace, the rest combines with the coal gas, forming a gaseous mixture, the volume of which is far greater than that of the air previous to its introduction into the furnace. This mixed air acts on the piston of the *cylindre moteur* with a force proportionate to the increased volume produced by the elevation of the temperature."

THE QUARTER'S SHIPBUILDING.

Lloyd's Register Shipbuilding Returns for the quarter ended September 30th, show that the tonnage under construction in Great Britain and Ireland—1,468,408 tons—is about 48,000 tons less than at the end of June last, but shows an increase as compared with twelve months ago of about 197,000 tons. The average tonnage being built during the twelve months immediately preceding the war was 1,890,000 tons, *i.e.*, 422,000 tons more than the present total.

A considerable decrease is shown in the tonnage commenced during the quarter, namely, 252,745 tons, as compared with 375,210 tons during the second quarter of 1924. The tonnage launched during the quarter—360,219 tons—is only 4299 tons lower than that for the June quarter, which was the highest reached during the last 2¼ years. The tonnage of motor ships being built at the end of September in Great Britain and Ireland reached 387,670 tons, equal to nearly 36 per cent. of the steam tonnage under construction.

The total merchant tonnage being built in other countries—1,112,604 tons—is about 12,000 tons more than at the end of June. The figures for the leading countries abroad are:—Germany and Danzig, 408,617 tons; France, 137,210 tons; Italy, 132,457 tons; Holland, 88,643 tons; Denmark, 77,899 tons; and Sweden, 69,240 tons.

There is a table giving the number and tonnage of vessels launched and of vessels commenced in the world during the quarter under review. From it we gather that 278,008 tons were laid down abroad and 192,372 tons were launched, an increase of 34,114 tons in the tonnage commenced and of 28,706 tons in the tonnage launched. The total world tonnage—2,581,012 tons—is 865,546 tons below the highest pre-war record reached on June 30th, 1913, viz., 3,446,558 tons. There are at the present time under construction in the world 35 vessels of between 10,000 and 20,000 tons each and 8 of 20,000 tons and upwards. Twenty out of the 35, and all the larger vessels, are being built in Great Britain and Ireland. The returns show that there are at the present time 43 steamers and motor ships, each of over 1000 tons, with a total tonnage of 290,220 tons, under construction in the world for the carriage of oil in bulk. Of these tankers, 22 of 133,820 tons are under construction in Great Britain and Ireland, and 11 of 95,500 tons in Germany.

The tonnage of vessels now being built in the world which are to be fitted with internal combustion engines amounts to 939,899 tons, while the tonnage of steam vessels under construction is 1,621,569 tons. The motor tonnage thus equals nearly 58 per cent. of the steam tonnage, which shows the remarkable development that is taking place in the adoption of this system of propulsion. Of the combined tonnage being built in Germany, Denmark and Sweden, nearly 78 per cent. consists of motor ships. The world figures include 85 motor ships each of between 5000 and 10,000 tons; 7 of between 10,000 and 15,000 tons; and 7 of between 15,000 and 22,000 tons.

Of the vessels under construction in the world—which total excludes vessels the construction of which has not actually been begun and also all vessels of less than 100 tons—410 of 1,684,139 tons are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register Book.

Engineering Contracts in Argentina.

Notwithstanding the Argentine Government's expressed intention of effecting economies it has been resolved to proceed with the majority of the many important engineering projects already approved by Congress. These include an expenditure of 28,000,000 pesos (paper) during the current year on State Railway communications, comprising the following projects:—Salta to the Chilean frontier, 5,000,000 dollars; extension from kilometre 448 to Bariloche, 2,500,000 dollars; San Antonio to Patagones and Embaracion to Yacuiba, 2,000,000 dollars each; Catamarca to Tucumán, 1,772,222 dollars; Federal to Curuzú Cuatia, 1,900,000 dollars; Rosario-de-la-Frontéra to Antilla, 1,233,333 dollars; La Banda to Santiago-del-Estero, 1,200,000 dollars; Puerto Madryn to Colonia 16 de Octubre, 1,000,000 dollars; and a number of smaller lines, together with improvement and re-equipment of existing systems. The completion, in some cases even the commencement, of the schemes, however, depends upon the ability of the Treasury to finance them.

Construction, at a cost of 11,700,000 paper pesos, has been begun upon a new line to unite Federal and Concordia in the State of Entre Rios.

The withholding of financial support is interfering with the speedy completion of the new port works at Buenos Aires. Meanwhile the docks are being dredged to enable vessels drawing 30ft. to proceed direct to their discharging berths instead of, as at present, unloading part of their cargo elsewhere.

Work has been commenced upon the construction of a new quay on the southern coast of Argentina to enable deep-draught steamers to reach Puerto Deseado. Although favourably situated and protected from adverse winds, the port has hitherto proved almost useless on account of the danger of approach, save at certain periods, owing to the extreme range of the tides.

Plans have been prepared and laid before the Minister of Public Works for the construction of a national port at Bahía Blanca, situated between Puerto Galvan and Ingeniero White. The cost of construction is estimated at 5,000,000 paper pesos. It is proposed to undertake the work in sections, that for the current year costing 1,000,000 dollars.

In connection with the development of the Government oilfields, construction will shortly be begun of a large distillery and cracking plant at La Plata. The establishment will be able to deal with 2000 tons of crude oil daily, and the works are expected to be completed and opened for operations at the end of the current year, by which time 1000 tons of oil should be dealt with daily. The plans adopted allow of easy duplication of the plant. The distillery will be connected by means of pipe lines with the industrial town of Avellaneda, situated on the banks of the Riachuelo, facing the capital. Additional construction will include extensive tanking accommodation at La Plata, with a wide frontage to the entrance channel of that port, affording direct means of communication with the naval base established there.

Other contracts to be arranged include a comprehensive irrigation scheme for the Province of Mendoza, the object being to provide a continuous water supply to irrigate another 40,000 hectares of some of the most fertile land in the State. The project includes increasing the capacity of the irrigating power of the Atuel, Diamante and Tuyuan rivers and the extension of the dams on the Uspallata and Mendoza rivers.

A modification has been determined upon in connection with the original scheme for constructing the Mitre Ship Canal from Buenos Aires to the river Parana, now reduced to an approximate length of 35 kilom., capable of accommodating vessels drawing 30ft. of water. Under the new conditions the outlay should not exceed 10,000,000 dollars (gold), the work being carried out by the Port Authority. Finally, the Government has decided to modernise the military establishment at Buenos Aires, devoting for the purpose a sum of 100,000,000 pesos, instead of 150,000,000 pesos as originally fixed.

At the meeting of the Diesel Engine Users' Association on October 3rd a paper by Mr. P. H. Smith on "The Significance of Exhaust Temperature," was read and discussed. The author gave interesting details on the subject of tuning up an oil engine by means of pyrometers recording the exhaust temperature, the indicator card being used only for the purpose of adjusting the firing point and compression. In a table of exhaust temperatures and loads over a period of several years, attention was drawn to the fact that when operating on tar oil, the exhaust temperature appeared rather lower than with ordinary fuel oil, which suggested that exhaust temperature is also a function of viscosity of fuel, since tar oil is very much thinner than normal fuel oil.

Railway Matters.

We regret to hear of the recent death, after an operation, of Mr. H. K. Woodward, the Bristol divisional engineer, Great Western Railway.

The membership of the Railway Tribunal of the Irish Free State is as follows:—Judge Daniel J. O'Brien (chairman), Mr. Henry Mangan and Mr. John R. Kerr, with Mr. George O'Brien as registrar. Mr. Kerr is the general manager and engineer of the Cork, Bandon and South Coast Railway.

In our notice of August 22nd of the opening of the Hendon–Edgware extension of the London Electric Railways, it was stated that, owing to the strike in the building trade, the station at Burnt Oak was not ready. That deficiency is now about to be remedied, and the station will be opened on the 27th inst.

Following the delivery of fifty 20-ton wagons for coal traffic to the Great Western Railway, mentioned on page 236 of The Engineer of August 29th last, there has now arrived at Aberpergwm a further train of fifty wagons. They were made by the Gloucester Railway Carriage and Wagon Company, and will convey coal for shipment at Port Talbot and Swansea.

The four foreign members of the new German Railway Board, which has resulted from the Dawes Report, are:—Sir William Acworth, Signor Giuseppe Bianchi, M. Jules Jadot and M. Maurice Margot. Sir William Acworth needs no introduction; M. Jadot, is the chief engineer in the administration of the Belgium State Railways, and M. Margot is the director-general of the Paris, Lyons and Mediterranean.

The obstacle, mentioned in this column on September 5th, to the Dublin and South-Eastern Railway joining the proposed combined "Great Southern Railway" of Ireland is likely to be met by Mr. H. G. Burgess becoming a director of the new company. As such, Mr. Burgess as general manager of the London Midland and Scottish and as deputy-chairman of the Dublin and South-Eastern, will watch the interests of both companies.

On page 233 of The Engineer of August 29th allusion was made to a reduction in the loss of goods by pilfering. This improvement has, we find, been reflected in the compensation paid for losses of and damage to goods in transit. In 1919 the amount so paid was £1,379,413, in 1920 it was £2,039,204, and in 1921 £1,352,863. By 1922 there was a drop to £591,638 and last year it was £617,277. Allowance must be made for the higher price of goods in the earlier years, but it will account for only a proportion of the decrease.

We regret to hear of the sudden death, when visiting his chief at Derby on Thursday of last week, of Mr. F. E. Gobey, the divisional carriage and wagon superintendent, Wolverton, of the London, Midland and Scottish Railway. Mr. Gobey served his time with the Gloucester Carriage and Wagon Company, and went to the Lancashire and Yorkshire Railway at Newton Heath in 1897, with which works he remained connected until he removed to Wolverton last year, to succeed Mr. A. R. Trevithick on the latter's retirement.

The Stationery Office has recently published a Ministry of Transport return giving a census of the railway servants employed on British railways during the week ended March 29th last. It shows that there were 700,573 persons employed, as compared with 681,778 in 1923, 676,802 in 1922 and 735,870 in 1921. Of the 700,573 there were 631,149 adult and 45,554 junior male staff and 22,332 adult and 1538 junior female staff. It is significant that since grouping the numbers have increased and not been reduced, as was anticipated would be the case.

The census of railway employees in March last, of which a return has now been issued, shows that the London, Midland and Scottish Railway totals greatly exceed those of any other railway group. Out of 700,573 railway employees in Great Britain, the number on the London, Midland and Scottish Railway alone is 274,523, being nearly 40 per cent. One striking feature of the figures is the small proportion of women engaged. Classification of the male employees shows:—Shop and artisan staff, 118,371; clerical, 77,887; permanent way men, 65,751; engine drivers and firemen, 74,388.

The New Zealand correspondent of *The Times*, cabling under date October 2nd, says that the Minister of Railways, Mr. Coates, has presented to Parliament a programme for railway improvement in volving an expenditure of £8,000,000, to be spread over eight years. The works include the improvement of the terminals at Wellington and Auckland, the duplication of the Lyttelton Tunnel, important deviations, and an improved signalling system. The improvements are all designed to enable the railways to handle an increased volume of traffic economically. Mr. Coates anticipated that the improvements would be largely financed by curtailing other public works proposed. Besides these improvements there is to be expenditure upon rolling stock. Mr. Coates said that 25 locomotives were being ordered in Great Britain.

A message from Melbourne states that the Federal Parliament will shortly be asked to ratify the agreement between the Commonwealth, New South Wales and Queensland for the construction of a railway between Kyogle, in the north of New South Wales, and Brisbane, which will form one of the chief lines in the uniform gauge railway from Brisbane to Fremantle. The Commonwealth and South Australia have been conferring with a view to arriving at an understanding to link the Great Western line with the New South Wales railway system at Hay. This scheme would give a continuous standard gauge connection from Kalgoorlie through Port Augusta to Hay and Sydney, and then northwards to Kyog'e and Brisbane. The approximate cost of the proposals is estimated as follows:—Port Augusta to Hay (500 miles), £4,500,000; Kyogle to Brisbane (97 miles), including strengthening of the existing line between Grafton and Kyogle, £3,500,000; total, £8,000,000. The next step would be the extension of the uniform gauge from Kalgoorlie to Fremantle, which would provide a uniform system from the Pacific to the Indian Ocean, a distance of 3040 miles.

Notes and Memoranda.

The output of platinum from Colombia during the first quarter of this year was 16,000 oz., which compares with 40,000 oz. for the whole of last year.

The Canadian National Exhibition, Toronto, claims to have the largest and most costly building on any permanent fair grounds the world over—the Coliseum—which cost 1,500,000 dollars, and has 8½ acres under roof.

A dredger at work in the Bay of Miolles, in the Cherbourg roadstead, brought to the surface wreckage which, says the *North Mail*, has been at the bottom of the sea for nearly two and a half centuries. It is believed to have belonged to Le Triomphant, one of King Louis XIV.'s ships, which, with the Soleil Royale and Formidable, ran ashore and sank after the famous battle of La Hogue, when the Anglo-Dutch Fleet defeated that of the French.

In the September issue of the *South African Irrigation Magazine* there is an account of the hailstorm which occurred at Pretoria on Christmas Day of 1923. It is stated that one hailstone measured 4in. by 3½in. by 2in., and weighed 5.1 oz., while eight stones had an aggregate weight of 1 lb. 15 oz. The stones fell with such force that No. 22 gauge corrugated iron was pierced, and ¼in. plate glass, reinforced with 1in. mesh wire netting, was broken.

So hot were the sun's rays one day recently in Vancouver that when the big draw span of the Granville-street Bridge was swung open it could not, says the *Canadian Engineer*, be closed again because of the expansion of the steel car rails by the heat. After it was seen that it would be impossible to close the bridge until the steel had cooled, the fire department was called and played streams of water on the sizzling bridge. Traffic was held up for sixty-five minutes.

A short article in the *Chemical Trade Journal* refers to the increase in the compressive strength of some constructional materials when impregnated with molten sulphur. It is said that the strength of concrete may be increased as much as ten times, and that it will absorb from 14 lb. to 16 lb. of sulphur per cubic foot. Dense sandstone was increased in compressive strength from 9400 lb. up to 30,000 per square inch, while it absorbed 84 per cent. of its own volume of sulphur.

The successful use of sodium peroxide for the removal of paraffin from oil wells is indicated by recent experiments of the United States Bureau of Mines. From 100 lb. to 200 lb. of the reagent are introduced into the well either by dumping it in at the top or by putting it down in wire cloth, tin, or glass containers. If the well does not contain water, a little is run in. It is further stated that experiments by individual operators in the Appalachian and Mid-continent fields increased production of some wells from 50–100 per cent. by cleaning them out with sodium peroxide.

Shipments of rubber in liquid form from the plantations in the Far East to America have been steadily increasing for more than a year, and four lines of steamers are now equipped to carry cargoes of latex in their ballast and oil tanks. When the ships arrive at an American port, the latex is pumped into tank cars of the sort commonly used for the transportation of petroleum. A barge carries the tank cars alongside the ship. Practically the entire production of the plantations of the United States Rubber Company, in Sumatra and the Malay Peninsula, is now shipped to the United States as latex or in the form of "sprayed rubber."

An article in the *Engineering News-Record* describes the efforts made by a Chicago firm to increase its water supplies by constructing a pumping station, 357ft. below ground level, and connecting it by means of tunnels with ten existing wells, ranging from 1200ft. to 1500ft. deep. The water level is not given, but it was so low that air lifts would not work satisfactorily. It is noteworthy that although the tunnels, 4ft. by 6ft. in section, had a total length of 2800ft., all the wells except two were found without difficulty. The two exceptional wells were 9ft. 6in. and 11ft. out of position when they were met, as compared with their positions at the surface.

In a recent issue of the *Canadian Engineer* it was stated that the combined traffic in the various canal systems at Sault St. Marie, on the Great Lakes, amounted in 1922 to slightly over 66,000,000 tons, composed mostly of coal, iron ore and grain. "While," remarks our contemporary, "conditions, of course, are entirely dissimilar, it will be of interest to compare this traffic with that of the other great canals of the world. The most recent traffic figures are:—Manchester Ship Canal, 4,273,544 tons; Panama Canal, 10,884,910 tons; Suez Canal, 17,574,657 tons." These three canals, it is added, are in operation all the year round, while those at Sault St. Marie are only open when ice conditions permit of navigation.

During the recent voyage of the Maloja, the first vessel to carry the new Marconi wireless set for ships' lifeboats, the installation was subjected to a series of tests, while the lifeboat was cruising in Port Philip, Melbourne, there being a fresh breeze and a short and choppy sea. Clear, strong signals were received by the boat from the Maloja and from neighbouring wireless stations, and the operator, by means of the directional receiver of the set, was able to obtain bearings of any of them, within one point of the compass of accuracy. Signals transmitted from this type of lifeboat set can be clearly received by an ordinary ships' installation at distances over 50 miles.

An investigation by H. Burcharta has, states *Stahl und Eisen*, shown that when slag is granulated or crushed so as to form a sand which will pass completely through a sieve with 20 apertures per inch it is quite satisfactory as a fine aggregate for both mass-concrete and reinforced concrete. As slag sand is more porous than natural sand a dense mixture (such as 1 : 2 : 3) must be used for reinforced concrete, in order to protect the reinforcement from rusting. Light slag sand produces concrete of slightly lower strength than that made with natural (quartzose) sand, but with dense slag-sand the strength of the concrete is at least equal to, and is sometimes even greater than, that in which natural sand is used, because slag sand itself has cementitious properties. The setting and hardening of concrete made with slag sand are normal.

Miscellanea.

The new Master Cutler is Mr. W. W. Wood, junior. The Mistress Cutler is Miss Gertrude Wood, J.P.

Construction of the big power tunnel for the British Columbia Electric Railway at Stave Lake, B.C., has started.

Coal has been discovered, according to the *Iron and Coal Trades Review*, under a farm in the neighbourhood of Biddulph and Congleton, Staffordshire.

Work has been started again at the Ball Eye lead mines on the summit of Ember, Derbyshire, which have been purchased by Vincent, Ogden and Co., of Walsall.

The Dublin dockyard was opened on the 6th inst. by the new company, Vickers (Ireland), Limited, which recently acquired the premises, and a small number of employees has already been put to work making necessary preliminary preparations.

Of the five new cruisers which are provided for in the Navy Estimates for the current year, the one allocated to Devonport Dockyard, to be named H.M.S. Cornwall, was started upon on Thursday morning, the 9th inst., when the first keel-plate was laid by Lady Phillimore, wife of the Commander-in-Chief.

The question of the possibility of development of power alcohol from beet in this country has been under discussion for a considerable period, and we understand that the whole position will be reviewed by a special committee appointed to deal with it at a recent meeting of the British Empire Producers' Organisation.

Subject to suitable arrangements being made with the London and North-Eastern Railway Company, for finance, Hull Corporation proposes to seek powers to construct a new pier and pontoon to replace the existing inadequate structure. An estimate of £200,000 does not cover the whole of the works but the major portion of them.

The Secretary for Mines draws attention to the issue of a new edition of the "General regulations as to the installation and use of electricity at mines under the Coal Mines' Act, 1911, with explanatory memorandum." The general regulations are unaltered, but the memorandum has been revised and amplified in the light of the experience gained since the last edition in 1921.

A recent discovery of cobalt on the Belgian Congo has, says the *South African Mining and Engineering Journal*, been proved to be of excellent quality and in considerable quantities. A plant for the treatment of the ore will shortly be placed in commission, and it is anticipated that the cost of production will compare favourably with the price obtaining for the metal at present.

The Barrow Town Council has decided, subject to the approval of the Electricity Commissioners and the Government Department, to proceed with a scheme for the construction of a hydro-electric station at Backbarrow, near the foot of Lake Windermere, for utilising water power for the generation of electricity. The scheme has been introduced in an endeavour to meet the growing demand for current in North Lancashire.

The floating dock which sunk off the Noss works of Philip and Son, Dartmouth, last May, was raised on the 5th inst. The dock arrived in port on April 23rd last, and was moored off Noss, and when the German vessel Landkircher, 1767 tons, entered the dock it capsized and sunk. The salvage ship Ringdove's Aid tried unsuccessfully for some weeks to raise the dock, and at the end of July it was understood salvage work had been stopped. Work was started again, however, with successful results.

The movement which has been on foot for some years to establish an engineers' club in Birmingham similar to those already existing in London and Manchester, has now reached the stage of the acquisition of an option on a building in Station-street, formerly known as the Shaftesbury Hotel. It is proposed to form a limited liability company with a share capital of £6000 divided into shares of £1 each, which are to be issued to members and supporters of the club. The date of the opening of the club has been provisionally fixed for January 1st next.

The second report of the Electricity Supply Commission concerning the future supply of electricity in Johannesburg means, in effect, according to the *South African Mining and Engineering Journal*, that there is no need for the municipality to spend half a million on a new power station. It makes a definite offer to supply Johannesburg with current at a price lower than the Municipality would require to charge for current from its projected new plant. It states that the Municipality's best interests would be served by a service of current from the Commission.

Work in connection with the electrification of the G.I.P. Railway is progressing very rapidly, and special arrangements are being made at Victoria Terminus, Bombay, where sixteen platforms will be constructed to afford every facility to the travelling public. Four substations have already been erected at Wari Bunder, Elphinstone Bridge, Kurla and Thana, where the construction of electric wire poles and lines is rapidly advancing. It is expected that a start with the electric trains will be made in February next year between Victoria Terminus and Kurla *vid* the harbour branch, while a month or two later electric trains will be ready to run to Bandra.

The production of the Tanganyika mines touched the annual rate of 100,000 tons of copper recently, and this quantity may be trebled in a few years' time by the treatment on an adequate scale of the large lower grade reserves, for which large leaching works in Central Africa are being installed. The erection of a hydro-electric refinery and the completion of the Benguella Railway is also requisite. These works, it is claimed, will result in a production cost at which no mine elsewhere will be able to compete. On the 60,000,000 tons of oxidised ore already exposed Mr. Williams estimates that there is a gross profit in sight of from £80,000,000 to £110,000,000.

MACHINES FOR THE MANUFACTURE OF STRANDED CABLES

JOHNSON AND PHILLIPS, LIMITED, CHARLTON, LONDON, ENGINEERS

(*For description see page 405*)

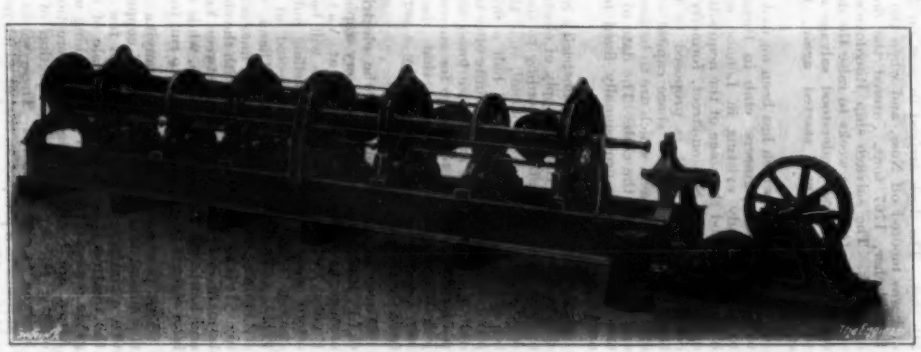


FIG. 94—HIGH-SPEED STRANDER

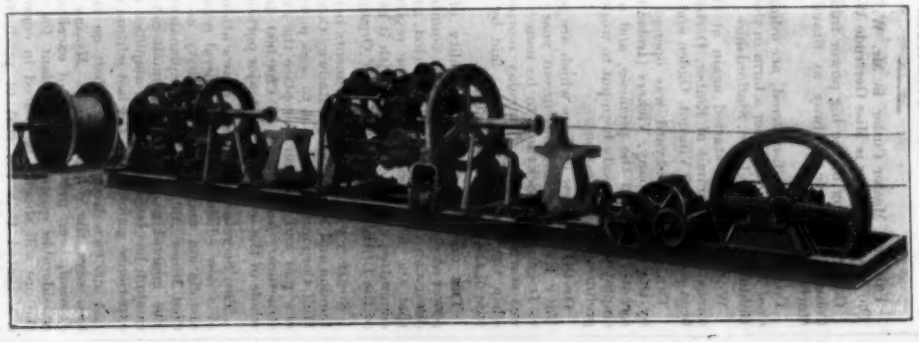


FIG. 95—DOUBLE TANDEM STRANDER

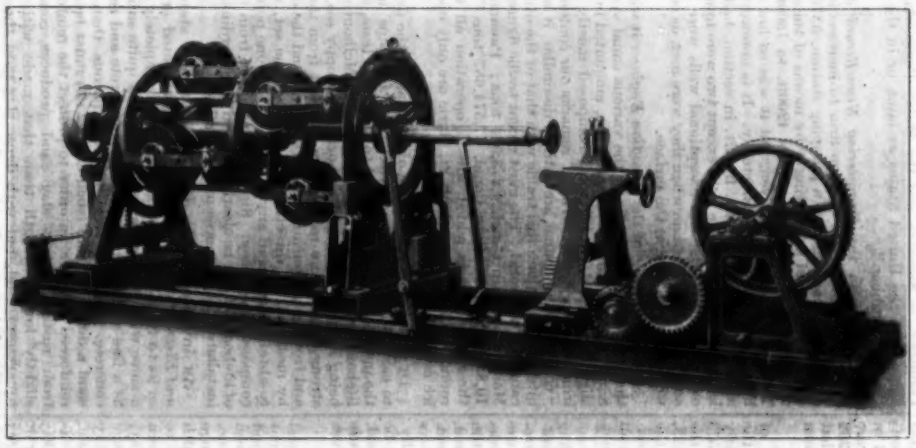


FIG. 96—SIX-BOBBIN STRANDER

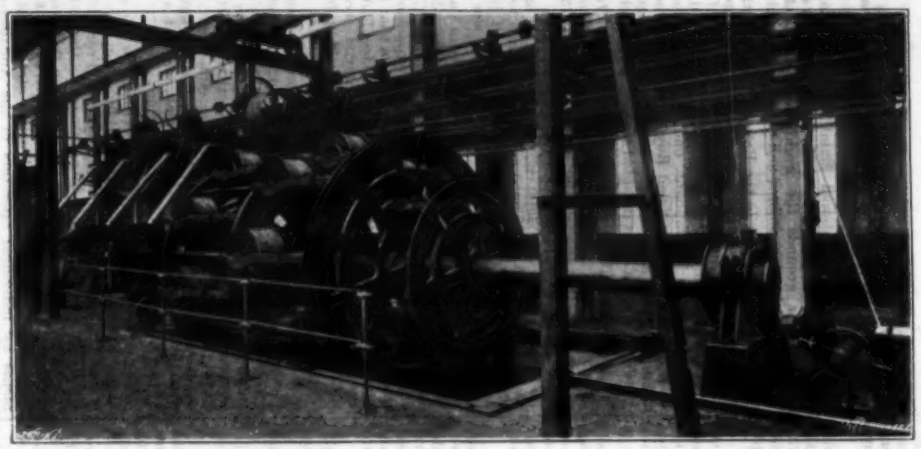


FIG. 97—LARGE CABLE MAKING MACHINE WITH 18 LARGE BOBBINS IN USE

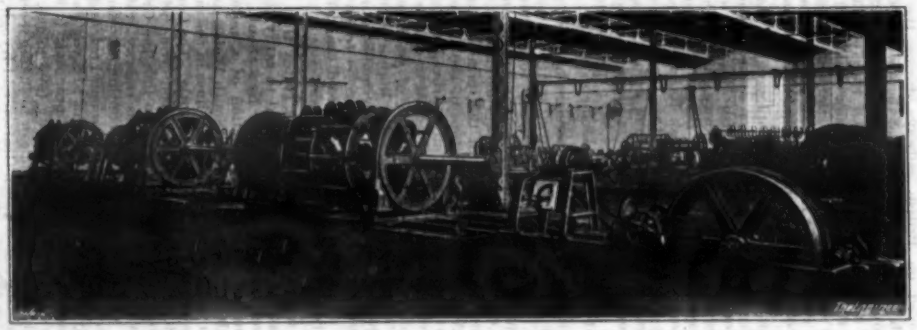


FIG. 98—LARGE TRIPLE TANDEM STRANDER

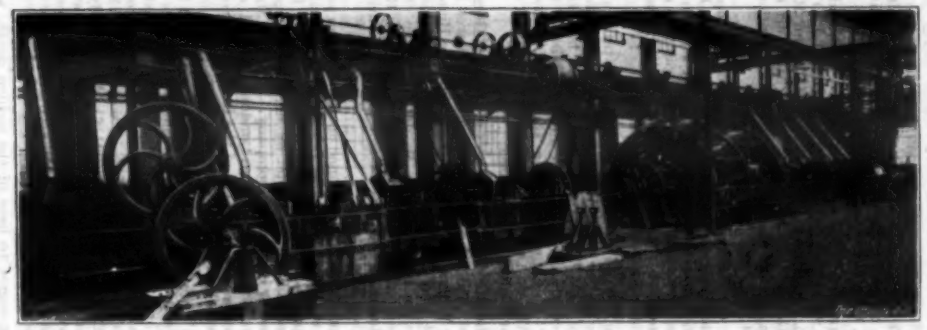


FIG. 99—REAR, OR INLET, END OF CABLE MAKING MACHINE

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THE ENGINEER.

OCTOBER 10, 1924.

Industrial Research.

The annual report of the Department of Scientific and Industrial Research, published last week, and of which one or two aspects were discussed in a leading article in our issue of October 3rd, calls attention to the present position of industrial research and particularly to the State-aided activities in that direction. These activities cover a wide range and appear to be of correspondingly widely varied value. Some, like the Museums, the Geological Survey and the National Physical Laboratory, were inherited by the present Department, and all that can be claimed is that the rule of the Department does not appear to have hampered their work and—in the case of the National Physical Laboratory—has allowed of a certain measure of much-needed further growth. None the less, it is by the way in which these permanent institutions are fostered and developed that the work of the Department is likely, in the long run, to be judged, since it acts as the trustee to the nation for what are in reality some of its most valuable and important possessions. The past record, present position, and future prospects of the Industrial Research Associations, however, constitute at the moment much more debatable ground, particularly as the future of many of them is at the present moment, or will soon be, in the balance.

There is probably little doubt, even in the minds of their most enthusiastic advocates, that as instruments for actual research these Associations are not particularly efficient; had it been possible to devote the same amount of money to the direct purposes of research there can be no doubt that a much greater volume of scientific results could have been obtained. But from the point of view of the advancement of our national industries the total volume of such research results is by no means the only factor to be considered. We are second to none in our belief in the great value of scientific research and its results, and consider that the nation—through its universities and public institutions—could and should profitably spend far larger sums of money on the encouragement and support of research. At the same time it must be recognised that something more is needed if our industries are to reap the fruits of the labours of our scientific men, and upon that something more we have insisted repeatedly; it is the will, the knowledge and the capacity of our industries to seize upon the results of research and apply them to their own needs or advantages. It is here that, it is claimed, lie the true functions of industrial research associations. By bringing the manufacturers and users of our commodities into direct contact with research as a practical matter, not only with the cut-and-dried results as they normally appear in print, but with the very conduct of research, with the men who carry it out and with the results as they are obtained, almost from day to day, it is hoped to bring about that better understanding of what research is and how it can serve industry that is so much needed. Is it possible yet to conclude whether this desirable result has been in any measure achieved? The report of the Department takes an optimistic view. Of the twenty odd Associations which have been formed, only one—the Glass Research Association—has come to an end; another finds itself able to continue its activities without further State aid, while several others have been given the promise of grants on a rapidly diminishing scale for a further five-year period. The majority will only approach the end of their first five-year period during the next two years, and in regard to these it is difficult as yet to form any opinion. The optimism of the Department seems justified to a certain extent by the facts relating to those Associations whose activities have so far been reviewed by the outside "Inspectors" whom the Department has consulted. In arriving at such views, however, it has unfortunately been necessary to give full weight to the very adverse conditions of industry during a large part of the period under review, and this factor also makes any conclusive judgment difficult. The ultimate test of the value of a Research Association is not only whether the industry has been brought to a sufficient state of appreciation to support the Association, ultimately, without State aid; but whether, as a result of the work of the Association, the whole state of the industry has been advanced. The factors governing the state of an industry, however, are so complex that progress arising from research may, for a time, be more than masked by retrogression owing to other causes. All we can say at the moment is that, if the majority of the industries which have established Research Associations are brought to the point of substantial appreciation which is expressed in cordial and continued support of research, a step forward will have been taken and the scheme may be said to have justified itself.

In detail, the report of the Department contains many points open to criticism. Perhaps the most serious is that the further financial support offered to some of the Associations appears to be on a narrow scale calculated upon a decidedly rapid increase in the support obtainable directly from the industries. While we sympathise with the desire to economise public funds and to lead the Associations to independence as rapidly as possible, too rigorous a policy of this kind may easily defeat the very objects of the whole scheme. The process of leading the men of industry to appreciate research is a slow one, and in many cases a considerable portion of the Association membership is on a precarious footing. Men who have joined these Associations without fully realising their importance are apt to look for early results of direct financial value, so that, after a few years, it becomes difficult to retain their membership. If larger subscriptions are demanded they may easily break away entirely, and their loss—even if the Association is able to survive it—must react unfavourably on educational objects of the scheme. We cannot help feeling that in many instances the continuance of the full pound-for-pound rate of grant for two or three years after the end of the first five-year term would be a wise step. Something like half a million has been spent so far on the existing Associations; it would be more than a pity to lose a considerable part of it, by the expiration of some of the Associations, owing to too close a hoarding of the remaining half of the "million fund." The somewhat miserly treatment which some of the Associations seem to be receiving acts also as a discouragement to some of the men who—whether as directors of research, as members of councils and committees, or as actual investigators—have done their best to help the Associations forward. Research itself is, of necessity, a slow and laborious business; to bring it home to the minds and activities of the industrialist and to bring him to a state of whole-hearted appreciation is still slower. Much patience is required, and it should surely be shown—in the form of really adequate further financial support—by the Government Department responsible for the administration of the scheme.

Synthetic Petrol for Motors.

The needs of the agricultural industry for cheap motive power have done more than anything else to impress upon the French the necessity of providing a satisfactory substitute for imported petrol.

The problem naturally goes much beyond the requirements of an industry, for when oil has become such an important factor in national defence, the country cannot remain indefinitely dependent upon foreign supplies. At the moment, the high cost of petrol is regarded as a serious impediment to the recovery of the agricultural industry, which is suffering from a labour scarcity that is obliging the country to import increasing quantities of grain. The only remedy suggested is a more general employment of tractors, but the farmer finds that the fuel cost is too high to allow of their economical employment. It is true that he is encouraged to believe in an ultimate distribution of cheap electrical energy, but there is still much to be done before such hopes can be realised, and for the moment he must depend upon the tractor if he would put more land under cultivation. At the annual trials of tractors, carried out last week by the Chambre Syndicale de Motoculture, a special section was organised by the Comité Central de Motoculture, which is a department of the Ministry of Agriculture. That section was devoted entirely to tractors running on fuels derived from home and colonial products. So far, the only practical results have been obtained with tractors equipped with suction gas plants, and during the trials near Versailles three or four new systems were presented, which seems to confirm the generally accepted idea that the suction gas tractor is in a fair way to become a practical success. Apart from the special attention that has to be given to the suction gas plant, there appears to be little trouble arising from its use, and the only serious drawback is the drop in efficiency when the gas is employed in engines designed for the consumption of petrol. That was observable during the trials, when engines that possessed little margin of power beyond what was required for ploughing, found themselves occasionally in difficulty. The economy of the suction gas tractor cannot be gainsaid, whatever may be the extra cost of maintenance, and it is affirmed that a still greater saving may be effected by the use of peat coke, which was employed in an endless track Citroën car. That vehicle, fitted with a suction gas plant weighing only 265 lb., demonstrated the suitability of such fuel during the trials. The low-temperature carbonisation treatment, by which it is produced, is claimed to have reached a commercial stage, and whether or not the results are as economical as claimed, it is evident that peat coke is excellent for suction gas vehicles, and an economical production of it would add considerably to the available sources of fuel.

But whilst the employment of suction gas plants may present a partial solution of the problem of cheap fuels, particularly in countries and districts where charcoal can be produced at very low cost from undergrowth, the supply of which is constantly renewed, there can be no exclusion of foreign oils until they are replaced by petrol obtained from home or colonial sources. In this connection the numerous varieties of petrols and oils produced by the catalytic process of Professor Mailhe, of Toulouse, and shown by the Comité Central de Motoculture during the trials of agricultural tractors, were highly instructive. Every kind of vegetable product can be made to supply petrol of exactly the same characteristics as petroleum spirit, but the commercial success of the process is only possible where unlimited supplies of produce, especially earth nuts, are available. Even where produce is grown for the manufacture of edible oils in the colonised territories near the coast of Africa, the supplies are insufficient to allow of the synthetic production of petrol at low cost. It is therefore proposed to obtain what is needed in Central Africa, where the raw material is so abundant that it costs nothing. Professor Mailhe has continued his researches in the direction of simplifying and cheapening his catalytic process, and by employing new catalysers he has reduced the cost of treating the oils to an extent that ensures a commercial production of petrol under conditions where vegetable oils are obtainable at low cost. According to the experts who are investigating this problem on behalf of the Comité Central de Motoculture, synthetic petrol can be produced at a quarter of the price at which imported petrol is sold at the West African ports. The transport of vegetable oils from Central Africa to the coast would appear to offer enormous difficulties, but we are assured that they can be overcome by the use of endless chain tractors, which, having already crossed the Sahara Desert, are perfectly capable of traversing Africa from the centres of oil production to the ports of shipment. A vast organisation would, of course, be needed, but the scheme appeals to the imagination of the French, who believe that the time is not far distant when their dream of an oil industry, drawing its supplies from inexhaustible sources in Central Africa, will be realised. It is still a debatable question whether the supplies of synthetic motor fuels will be drawn more especially from one inexhaustible source, such as the vegetable products of the Colonies, or whether they will be procured from the practical development of a variety of processes, including the low carbonisation of coal, peat and other products. During the trials of agricultural tractors near Versailles a two days' congress was held in Paris to review the situation. The synthetic production of alcohol appears to have been more or less abandoned, except in Germany, where the problem is still being investigated, and the French are far less confident than they were a year or two ago in the future of power alcohol. So far, no means have been found of bringing down the cost of that fuel to a competitive level, and the necessity of rectifying alcohol for use as a motor fuel is a serious hindrance to its employment. Interest in alcohol has been completely eclipsed by the hopes that are being raised in the catalytic treatment of vegetable oils. The communications at the congress made it clear that a great deal of progress is being made in this direction, and amongst some chemists optimism is carried to the extent of affirming that the success of the catalytic process, as a means of building up a vast petrol industry in tropical territories, is already assured.

In view of the economic difficulties to be encountered, however, it can only be said that there are probabilities. It is evident that other processes, such as the hydrogenation of coal and other solid fuels and the production of synthetic petrol from lignites which is being accomplished by Messrs. Audy-Bourgeois and Olivier, may reach a practical stage of development before sufficient quantities of vegetable oils are available for catalytic treatment. But while all these different methods are more or less experimental, the results being obtained are so far encouraging as to minimise the importance of the exhaustion of existing mineral oil deposits. Whilst the French are perfectly convinced that they are on the high road to the creation of a vast colonial petrol industry, there is little being done in the way of adapting internal combustion engines to the new fuels. No builder will go to the cost and trouble of experimenting with new engines unless he is assured of ample supplies of cheap fuel. He finds that he was perfectly justified in maintaining a reserved attitude towards alcohol, and he is not sure whether it is expedient to design lorry engines for running on suction gas, especially now that he is offered the possibility of eventually procuring supplies of cheap colonial petrol.

Exploding the Atom.

The advances of physical science have in recent years been so rapid and startling that the public, and even those who possess some knowledge of science, stands prepared for further marvels. So much that was formerly regarded as impossible has become a matter of simple fact, and so much that was thought to be firmly established and universal truth has been shown to be but one portion or aspect of a much larger and unsuspected truth, that we very naturally feel that nothing, however startling, can be regarded as really impossible or even improbable. On this basis, the untrained imagination is apt to run riot, and there are not wanting those who are ready and anxious to turn that imagination to their own advantage. Fortunately, there are men who have both the knowledge and the courage to expose the worthlessness of incredible claims, as in the recent case of the so-called "Death-ray," however cleverly put forward. This courage does not, as the credulous declare, consist in standing in the path of true scientific development, but rather in exposing anything that claims to be a new scientific discovery and is not; since the scientific expert knows better than anyone how easy it is to discredit something really new, simply because it appears to be contrary to "known" facts or laws.

Throughout the ages, humanity has displayed an astonishing readiness to accept successive predictions of the destruction of the world. It is not perhaps quite so easy to gain credence for prophecies of that sort to-day, when a large section of the community is reasonably well educated as in the past, and there is at least one large body of men—the trained engineers—who would be bound, from the very nature of their calling and of the mental attitude which it induces, to treat scare-mongering of the kind with the indifference which it deserves. The columns of certain of the more sensational daily papers of the last few weeks show that an attempt to make our flesh creep with a scare of this sort has been made in reference to the "explosion of the atom." It is not perhaps necessary to analyse how far the blame is to be apportioned between journalism and science. The journalist, at least, may be pardoned to this extent, that sensation-mongering is his business, demanded of him by a certain section of the public, and that he is without sufficient scientific or technical knowledge to discriminate between the real and the false in scientific matters. Even so, however, a little discernment might have warned him that genuine scientific discoveries of first-rate importance are never announced to the public *before* they have been made. It is, however, a matter for something more than grave regret that a man holding a position in one of our universities, and claiming certain scientific qualifications, should have become the centre of that kind of publicity. Even if it were nothing more than the theatrical premature announcement of an achievement which as yet exists only in imagination, we should have ground for strong criticism. But the "exploding the atom" story has a more serious feature, since it is strongly suggested that success in the endeavour in question might lead to a progressive and rapid disintegration of atoms, spreading far and wide, and leaving our world no more than a cloud of incandescent helium gas. It is this aspect of the "sensation" which puts the present effort on a par with the earlier "end of the world" predictions, and we do not doubt that it has already done some direct harm among nervous and credulous persons. It is, however, harm of an indirect character that is likely to be more serious. We have, in the first place, the degradation of scientific method by dragging it down to the level of sensation-mongering journalism; beyond that is the serious risk that it may raise in the public mind a real fear that the pursuit of scientific research may be fraught with possibilities and risks of great harm to mankind in general. The part which science had, unhappily, to play in the Great War has already given rise to the fear in some minds that the ultimate result of scientific advance may be destruction rather than progress. It is most unfortunate that "scare headings" should spread such a fear still further and into much more dangerous quarters. It should be unnecessary to say that if there were any real fear of the kind of cataclysm which is foreseen by nervous people the whole body of scientists would rise up to prevent the prosecution of the experiments.

To the engineer, this problem of "exploding the atom" is one of very special interest, since if the reservoir of power which is undoubtedly locked up within the atom could be rendered available, the world-wide problem of power supply would be solved. The question whether or not this is likely to be achieved in the near future is too large and too highly technical—in the sense of advanced physical theory—for discussion here. Among those best qualified to know, the view is held that such a result is not very likely to be achieved in the near future. At all events, up to the present only a few isolated atoms of some of the lighter elements have been broken up in the laboratory of Sir Ernest Rutherford at Cambridge, and at an expense in power greater than any energy released in the process. Actually, we have in radium an example of the release of power by the disintegration of an atom, but this is a spontaneous process of Nature, and one which we cannot in any way influence—a certain number of radium atoms break down explosively every second, wherever we may place them or whatever we may do to them. When they do break down, they emit certain particles or "rays," which possess an enormous amount of energy, and, in favourable circumstances, they can penetrate what might be termed the outer defences of the lighter and weaker atoms and break them down into still lighter units. But that only occurs with very great difficulty. Even, therefore, if we could assume that the collection of electrical apparatus which seems to have been assembled for the alleged attempt to render ordinary matter radio-active—for that is what it comes to—were to succeed in causing any outburst beyond a journalistic one, there is little or no reason to suppose that atomic disintegration artificially induced would spread from atom to atom with devastating force. After all, the material universe has existed more or less as we know it for many millions of years. During portions of that period, while our present chemical elements were being produced, either by radio-

active disintegration from heavier atoms or by a converse process of synthesis, the conditions favourable to the rapid spread of atomic disintegration must have existed, if they are capable of existing at all, and yet the elements still remain with us, and helium—the last product of possible atomic disintegration—is not a particularly plentiful ingredient of this world of ours. The probability, therefore, that either the present experiments or others of a more serious nature would cause serious consequences is so slight as to be negligible. Meanwhile, the spread of sensational rumours and predictions is not only harmful to the general public, and to the advancement of science and technology generally, but most of all injurious to the reputation of a university which has had the misfortune to have its fair name dragged into an affair of this sort.

One Hundred Years of British Railways.

No. XV.*

PART II.: THE FIRST HALF CENTURY.

THE GREAT WESTERN RAILWAY.

In our last issue we traced the origin of the Great Western Railway and of the construction and opening of the line between Paddington and Bristol. Before proceeding with the history of that railway generally, it is necessary in order to deal with events in their chronological order, to mention a line that became jointly owned with the London and North-Western—the Birkenhead Railway, opened on September 22nd, 1840. In case any explanation may be considered necessary, it should be said that the jointly owned Shrewsbury and Hereford was covered in the articles relating to the London and North-Western Railway, as that company, and not the Great Western, is the greater user of the Shrewsbury and Hereford. Conditions are the reverse in respect of the Birkenhead; the Great Western is, by far, the predominant partner. It is for that reason that it is dealt with here.

The Birkenhead Railway was originally known as the Birkenhead, Lancashire and Cheshire Junction Railway, and was sanctioned by 9 & 10 Vic., c. 91, 1846, and by 10 & 11 Vic., c. 222, 1847. The company took over the Chester and Birkenhead, which had been authorised in 1837 by 1 Vic., c. 107. It had powers to make several lines of railway, but only those from Chester to Birkenhead and from Chester to Walton Junction, south of Warrington, on the London and North-Western main line, were constructed. The former was opened on September 22nd, 1840, and the latter on December 18th, 1850. Running powers over the London and North-Western into Manchester (Victoria) were obtained in 1846, and gave the Great Western the access to Manchester which is enjoyed to this day. On the Birkenhead line is Moston Viaduct of eleven arches, and on the Warrington line Frodsham Tunnel and Sutton Tunnel. The latter lies between Hulton and Norton stations, is 1 mile 160 yards long, and was the scene of the serious collision of April 30th, 1851, referred to in the opening lines of our Article No. XIII. In October, 1844, the line at Birkenhead was extended to a new terminus on the shore of the Mersey at Monk's Ferry. This extension necessitated the construction of a tunnel, 497 yards in length. By 22 & 23 Vic., c. 74, 1859, the name of the company was altered to the Birkenhead, and a loop between Hooton, on the Birkenhead line, and Helsby, on the Warrington line—opened on July 1st, 1863—was sanctioned. When the Great Western, in 1854, absorbed the Shrewsbury and Chester it proposed to take the Birkenhead also. This proposal failed to find acceptance, the London and North-Western being preferred. In 1860 the line was vested in the Great Western and London and North-Western, and was managed by a joint committee, as it is to this day. By 25 & 26 Vic., c. 198, 1862, a line from Hooton to Parkgate, on the Dee Estuary, was sanctioned. It was opened on October 1st, 1866.

The year after the London and Bristol Railway was sanctioned saw the incorporation of the Cheltenham and Great Western Union—7 Will. IV., c. 77, 1836—for a line from the Gloucester and Cheltenham—see Article No. V.—at Gloucester to Swindon, together with a branch between Kemble and Cirencester. The company was authorised, jointly with the Birmingham and Gloucester—later the Midland—to purchase the just-mentioned Gloucester and Cheltenham. This was done; the line was modernised and re-opened on November 4th, 1840. It was provided in the original Act that there should be a joint station in Cheltenham, but in 1839 the company decided that it would have its own station in both Cheltenham and Gloucester. That in Cheltenham is on the east of the Midland, Lansdown, station and the line leaves the Gloucester and Cheltenham at Lansdown Junction; that at Gloucester is to the west of the Midland station, and the line leaves the Gloucester and Cheltenham at Barnwood Junction. Trains for Swindon left the Gloucester terminus in a northerly direction, crossed the Midland metals on the level at Tramway Junction, just outside the station, curved to the east and then to the south. When the Bristol and Gloucester was opened on July 8th, 1844, that company's trains used the Cheltenham and Great Western Union lines between Gloucester and Standish Junction, a distance of about 7 miles. This arrangement continued until after the Midland had acquired the Bristol and Gloucester, and laid in an independent line between its station in Gloucester and Standish Junction—opened May 29th, 1854. Brunel was the engineer, and the most important work on the line is the Sapperton Tunnel, and an approach tunnel, 16 chains in length, to its east. The total length of the two is 2212 yards. Of the ten shafts used in its construction, one near the middle remains for ventilation. Coming from Gloucester, Sapperton Tunnel is approached by a stretch, 4 miles in length, rising from 1 in 60 to 1 in 100. Nearly 2 miles west of Kemble, the line crosses the Thames and Severn Canal by a bridge on a skew of 38 deg., which increases the span of 32ft. on the square to nearly 52ft. St. Mary's Viaduct, over the same waterway, had a skew of 23½ deg. and a span of 30ft. on the square and of 75ft. on the skew. The Bourne Viaduct, again over the canal, had seventeen spans on a skew of 44 deg., and was immediately succeeded by Capel's Viaduct, which had eighteen spans, of 30ft. each, all on the square. Watt's Viaduct, at Stroud, had eight bays of 30ft. span in timber and four stone arches of 27ft. span. Bridges were somewhat numerous, owing to the narrowness of the valley, coupled with the presence of the canal.

The Cheltenham and Great Western Union was opened in two portions. The first, brought into use on May 31st, 1840, covered the section from Swindon to Kemble and the Cirencester branch. The remainder was opened on May 12th, 1845. The line was acquired by the Great Western in 1844.

The same year, 1836, witnessed the sanction, by 6 Will. IV., c. 36, of the construction of the Bristol and Exeter Railway between those points, together with branches to Clevedon, Weston-super-Mare and Tiverton. Branches to Yeovil, Crewkerne, Wells and Glastonbury and to Castle Cary were authorised between 1845 and 1848 inclusive. By 8 & 9 Vic., c. 88, 1845, an independent company obtained power to build a line between Exeter and Crediton, and, under the same Act, to lease or sell it to the Bristol and Exeter.

Brunel was the engineer for the Bristol and Exeter Railway, but retired from that position when he found that the duties clashed with those of his position as engineer to the Great Western. He was succeeded by Francis Fox, the father of Sir Douglas and Sir Francis Fox. The line was laid on the broad gauge, and its most important feature is Whiteball Tunnel, 1092 yards, which is on a gradient rising 1 in 127, when going towards Exeter, and is approached from Bristol by nearly 3 miles of 1 in 90, 1 in 86, and 1 in 80. From Exeter the summit is reached by 2 miles of 1 in 115. The station at Bristol adjoined that of the Great Western, and eventually became the main through portion of the Joint Station, for which the Great Western, Midland and Bristol and Exeter companies obtained powers by 28 & 29 Vic., c. 98, 1865. The bridge over the river Culme at Hele and one over the Exe near Exeter were unusual, in that they also carried a public roadway, 10ft. wide, at the side of the railway, with only a wooden fence between them. The latter bridge had six spans—four of 22ft. and two of 21ft. Nearer Exeter was another bridge, purely for railway purposes, over the Exe with six spans of 22ft. and two of 21ft.

The Exeter and Crediton was an early sufferer from the existence of two gauges. It was, of course, constructed on the broad gauge, being intended to be part of the Bristol and Exeter. Beyond Crediton there was to be a line to Barnstaple which, as the Taw Vale, was sanctioned as long ago as 1838. Its powers lapsed, but were revived when the Exeter–Crediton was authorised in 1845. The Taw Vale, also, was to be of the broad gauge in order that, together with the Exeter and Crediton, it might in accordance with the terms of the Act be leased to and worked by the Bristol and Exeter. Certain parties interested in the Taw Vale purchased 1700 shares in the Exeter and Crediton—rumour had it that the money was furnished by the London and South-Western—and, at a general meeting on January 11th, 1847, carried resolutions that the Exeter and Crediton be leased, along with the Taw Vale, to the London and South-Western. The next step was a resolution on July 3rd, 1849, that the gauge of the Exeter and Crediton be altered to 4ft. 8½in. That was done, but Parliament refused an amending Act to lease the line to the Taw Vale. On the top of that came the refusal of the Railway Commissioners to allow the Taw Vale to be of any other gauge than that—the broad—specified in the Act of incorporation. As a consequence, the Exeter–Crediton line, when opened on May 12th, 1851, was isolated and confined to a section between Cowley Bridge Junction, 1¼ mile north of Exeter, and Crediton. By 23 & 24 Vic., c. 103, the London and South-Western was, however, authorised to extend its main line from Queen-street Station, Exeter, to the St. David's Station of the Bristol and Exeter; to run over the Bristol and Exeter to Cowley Bridge; to lease the Exeter and Crediton and the North Devon (formerly Taw Vale); and to provide a mixed gauge. The Exeter and Crediton was thus leased to the London and South-Western as from January 1st, 1862, and from February 1st of that year the latter company ran over it, and it became part of the London and South-Western main line to the West.

On December 24th, 1841, there was a slip in the embankment on the down side of the line in Sonning Cutting between Twyford and Reading, and into this, about 7 a.m., a train, consisting of two third-class carriages and eighteen wagons, ran. The passenger vehicles had sides that were only 2ft. in height above the floor level, and the collision threw many of the passengers out, with the result that nine were killed. The carriages, further, had dead buffers, and Sir Frederick Smith, in reporting on the accident, recommended (1) that passengers should not be conveyed by goods trains; (2) that the sides and ends of the vehicles be 4ft. 6in. high, particularly as "the exposure to the cutting winds of the winter must be very injurious to the traveller, who, if proceeding from London to Bristol, often remains exposed for ten or twelve hours, a great part of which is in the night time"; (3) that all such carriages have spring buffers.

The Birmingham, Bristol and Thames Junction was authorised by 6 Will. IV., c. 79, 1836, for a line from the London and Birmingham at Willesden, across the Great Western main line on the level at a point about 40 chains south of the junction, to the west side of the Kensington Canal basin, nearly 300 yards to the southward of the Hammersmith-road, a total length of 2 miles 78 chains. The company was empowered to purchase the canal just named with the idea of converting it into a railway up to the north bank of the Thames at Chelsea. In 1840 the name of the line was changed to that of the West London, and, by 8 & 9 Vic., c. 156, was leased as from March 11th, 1845, to the London and North-Western and Great Western jointly. The West London Extension was a line in continuation thereof, which was made subsequently, and is differently owned. It took over the Kensington Canal. Incidentally, it lifted the West London out of the hopeless state into which it fell.

The line was at first single tracked, and laid with the mixed gauge so as to accommodate the broad-gauge traffic of the Great Western. Just before the railway level crossing was reached, there was an unusual two-decked bridge over the railway. It not only carried the Paddington Canal in a trough, 30ft. wide and 5ft. 6in. deep, and a towing path on each side of the canal, but a carriage road and a footpath on each side over the canal. The width between the parapets of the bridge was 107ft., and the work was so interesting as to be described in "The Public Works of Great Britain," by F. W. Simms (1838). When the railway level crossing was superseded by the line from the London and North-Western being carried over the Great Western, this bridge—usually spoken of, because of its length, as a tunnel—was completely walled up. There was a station, too, at this point on both the London and Birmingham and the Great Western Railway, and its buildings are still standing but buried amid their modern surroundings. The line was opened on May 27th, 1844. It may be added that it was on the West London Railway that Samuel Clegg and the brothers Samuda made, in June, 1840, a success with the atmospheric principle of working railways. This led to an installation being put down at Dalkey, between Kingstown and Bray, which was opened on August 18th, 1843.

The Oxford Railway—6 & 7 Vic., c. 10, 1843—was to join that city with the Great Western at Didcot. There were two timber bridges over the river Thames—one of ten bays, each of 30ft. span, and the other of seven bays of 40ft. span. The line was opened on June 12th, 1844, and in the same year was absorbed by the Great Western.

The South Devon was a line which ran from the Bristol and Exeter at Exeter to Plymouth, and was authorised by 7 & 8 Vic., c. 68, 1844. Brunel was the engineer for it also. The station in Exeter was, at first, some little distance from that of the Bristol and Exeter, but the latter company's line was continued to the South Devon Station, which is now a carriage shed near where the London and South-Western Railway enters. The present—St. David's—station dates from 1862, when a new one was built in order to accommodate the London and South-Western, which company, by 23 & 24 Vic., c. 103, 1860, was given power, as related above, to extend its line from its Queen-street Station, through St. David's, to a junction with the Exeter and Crediton at Cowley Bridge Junction, and for the Bristol and Exeter to lay a third rail to take the narrow gauge trains of the South-Western Railway.

There are some interesting features about the South Devon Railway. There are, for instance, the five tunnels immediately south of Dawlish Station—Kennaway, 210 yards; Coryton, 230 yards; Phillot's, 50 yards; Clerk, 60 yards; and Parson's, 375 yards—which are followed by the well-known sea wall up to Teignmouth Station. As far as Newton Abbott the line is practically level, but between that station and Totnes, a distance of about eight miles, there is the Dainton bank, with Dainton Tunnel at the summit. On this length there are, going west, short stretches of 1 in 46, 1 in 41, and 1 in 44 rising, and, when going east, 1 in 38 and 1 in 43. After leaving Totnes there is the climb, 9 miles long, to the summit at Wrangaton. The heaviest work is, however, done when Rattery Siding—4 miles from Totnes—is passed, as on this there are

* No. XIV. appeared October 3rd.

gradients of 1 in 66, 1 in 47, 1 in 50, 1 in 46, and 1 in 65. Marley Tunnel, just beyond Rattery Siding, rises throughout at 1 in 131. From Wrangaton, when going west, the line falls gradually for 7 miles to Hemerdon Sidings, and then at 1 in 42, 1 in 47 and 1 in 41 for 3 miles to Plympton. Immediately west of this point are Laira Sidings and there, when the South Devon line was built, it crossed, on the level, the Plymouth and Dartmoor Railway on the latter's way to Sutton Pool—see article V. The line to Sutton Pool was worked by horses. The South Devon acquired it under 17 & 18 Vic., c. 122, 1854, and converted it for use with locomotives.

The South Devon was opened as follows:—Exeter–Teignmouth, May 29th, 1846; Teignmouth–Newton Abbott, December 30th, 1846; Newton Abbott–Totnes, July 20th, 1847; Totnes–Laira, May 5th, 1848; and Laira to Plymouth, Millbay, April 2nd, 1849. The line was, at first, worked on the atmospheric principle. This was done on Brunel's recommendation, as he considered the line, because of the curves and gradients, particularly suitable. As is known the system proved a failure. It was not laid beyond Newton Abbott, and in September, 1848, was replaced by locomotives. The pumping engine-house at Exeter subsequently was used for the manufacture of oil gas for train lighting. Its elaborate chimney has only recently been demolished, as it was considered unsafe.

By 9 & 10 Vic., c. 402, 1846, a branch to Torre was sanctioned, and by 10 & 11 Vic., c. 242, 1847, was to be extended to Brixham. The branch was opened to Torre on January 1st, 1849. The Dartmouth and Torbay was an independent company, which was authorised under 20 & 21 Vic., c. 103, 1857, to extend this Torquay branch to Kingswear and to establish ferry communication across the Dart to Dartmouth. It was opened to Paignton on August 2nd, 1859, to Brixham-road on April 1st, 1861, and to Kingswear on August 16th, 1864. Under the act of incorporation the line was acquired by the South Devon.

A branch between the South Devon line near Laira to Tavistock was made by the South Devon and Tavistock under 17 & 18 Vic., c. 189, 1854. It was opened on June 22nd, 1859, and was acquired by the South Devon on completion. Its average gradient is 1 in 60, the summit being at Yelverton, which is 7¼ miles from the main line junction and 5½ miles from Tavistock. Under 25 & 26 Vic., c. 111, 1862, the Launceston and South Devon extended the line from Tavistock to Launceston. The extension was opened on July 1st, 1865, and was vested in the South Devon in 1869. The work includes six viaducts of from 63ft. to over 130ft. in height. The viaduct nearest Tavistock is 132ft. in height and has fifteen openings of 66ft. span each. Another independent company—the Moretonhampstead and South Devon—made, under 25 & 26 Vic., c. 128, 1862, the branch from Totnes to Moretonhampstead, which was opened on July 4th, 1866, and acquired by the South Devon in 1872. Part of this line was laid on the route of a tramway, built in 1820, to convey stone from Hey Tor. The steepest bit on the Moretonhampstead branch is 1 in 49 for nearly 2 miles beyond Lustleigh. The South Devon was amalgamated with the Great Western under powers obtained in 1878.

Few people journeying by the Great Western main line between Chester and Shrewsbury are aware that the first portion of that line was constructed for conveying coal from the counties of Flint and Denbigh. The first 10 miles 45 chains—from Chester to Wrexham—were to be built by the North Wales Mineral Railway—7 & 8 Vic., c. 99, 1844—which company was authorised by 8 & 9 Vic., c. 115, of the following year to extend the line to Ruabon, a further 12 miles 19 chains. Thence to Shrewsbury with a branch from Gobowen to Oswestry, was to be constructed by the Shrewsbury, Oswestry and Chester under 8 & 9 Vic., c. 42, 1845. Both companies were amalgamated as the Shrewsbury and Chester in 1846. The line was opened thus:—Chester–Wrexham on November 4th, 1846; Wrexham–Ruabon, December 2nd, 1846; Ruabon–Shrewsbury, October 14th, 1848. The Oswestry branch was opened in December, 1848. The outstanding engineering work on the line is the Dee Viaduct, 1532ft. long, with 19 arches of 60ft. span each, and 148ft. above the bed of the river. It cost £76,000. In 1854 the line became part of the Great Western Railway.

The Berks. and Hants—8 & 9 Vic., c. 40, 1845—was to build two lines:—(1) Reading to Basingstoke; and (2) Reading to Hungerford—and to sell or lease them to the Great Western. The latter of the two lines was opened on December 19th, 1847, and the former on November 2nd, 1848. Another company—the Berks. and Hants Extension—was authorised under 22 & 23 Vic., c. 105, 1859, to extend the Hungerford line to Devizes, which work was completed on November 11th, 1862. In 1866 the extension was leased to the Great Western.

On May 10th, 1848, a horse-box was left foul of the running line at Shrivenham, and struck a passing express. Six passengers were killed.

By 8 & 9 Vic., c. 53, 1845, the Wilts., Somerset and Weymouth Railway was sanctioned. It ran from Thingley Junction, Chippenham, to Weymouth, and had various branches. Other branches were authorised by 9 & 10 Vic., c. 313, of the following year, including one to join the Great Western at Bathampton. The Act of incorporation permitted the line to be leased to the Great Western. The line was opened thus:—Thingley Junction–Westbury, September 5th, 1848; Westbury–Frome, October 7th, 1850; Frome–Yeovil, September 1st, 1856; and Yeovil-Weymouth, on January 22nd, 1857. The Salisbury line was opened from Westbury to Warminster in October, 1851, and from Warminster to Salisbury on June 30th, 1856. The line between Yeovil and Durston on the Bristol and Exeter was brought into use on October 1st, 1853, that from Frome to Radstock on November 14th, 1854, from Maiden Newton to Bridport on November 12th, 1857, and from Witham to Shepton Mallett on November 9th, 1858. The line was absorbed by the Great Western in 1851.

The Shrewsbury and Birmingham Railway was sanctioned by 9 & 10 Vic., c. 307, 1846, to take over the Shrewsbury, Wolverhampton and South Staffordshire Railway, authorised by c. 308 of the same session. Actually, its purpose was to build a line from Wellington on the Shropshire Union to Wolverhampton, which was opened from Wellington to Oakengates on June 1st, 1849—on the same day as the Shropshire Union from Shrewsbury to Stafford, as related in article No. XII., and from Oakengates to Wolverhampton on November 12th, 1849. South of the former station is a tunnel 400 yards long. The Shrewsbury and Birmingham became part of the Great Western in 1854.

The South Wales Railway—8 & 9 Vic., c. 190, 1845—was a most ambitious scheme. It covered not only 161 miles of railway between Chepstow and Fishguard, but aimed at steamship communication between the latter place and Wexford. Brunel was both the father and engineer of the idea. The line ended, however, at Milford instead of at Fishguard, and not until August 30th, 1906, was there a regular steamship service between Fishguard and Ireland. The line, at its eastern end, had no physical connection with any other railway, but in 1846 by 9 & 10 Vic., c. 239, it was to be extended from Chepstow to Awre, in order to join the Gloucester and Dean Forest. Later, it was agreed with the latter company that the South Wales should also make the line between Awre and Grange Court. The same Act also sanctioned a branch from Newport to Monmouth. The line is fairly free from severe gradients; the only trying examples occurring on the 11 miles between Neath and Gowerton. Here Cockett Tunnel is approached from the east on a rising gradient of 1 in 52 and from the west by 1 in 53 and 1 in 50.

The two most interesting engineering features on the line were the tubular bridge over the Wye at Chepstow and the Landore Viaduct. The former is 610ft. long and consists of four spans, three of which are of ordinary girder construction, 100ft. in length. The fourth span is a tube 309ft. long and 9ft. in diameter. The Landore Viaduct was a timber structure—since replaced in stone—over the valley of the Tawe, the Swansea Vale Canal and a main road. It was 1760ft. long; the main span over the river was of the bowstring principle and 100ft. in length; those over the canal and the main road 73ft.; two over occupation roads 50ft., and the others were 42ft. and 36ft.

The first step from Oxford towards Birmingham was taken by the Oxford and Rugby Railway—8 & 9 Vic., c. 188, 1845—which company was authorised to build a line between the two places named. It was, however, only built to Fenny Compton, and was opened from Oxford to Banbury on September 2nd, 1850, and thence to Fenny Compton on October 1st, 1852. The Birmingham and Oxford Junction—9 & 10 Vic., c. 337, 1846—filled the gap between Fenny Compton and Birmingham, being opened on October 1st, 1852. At Harbury, on the latter line, is a cutting ½ mile long and 110ft. deep, whence 3,000,000 cubic yards of excavation were removed. At Warwick is a viaduct of thirty arches, each of 25ft. span, and an iron girder bridge of 150ft. span. The Solihull Viaduct is 500ft. long. Both the Oxford and Rugby and the Birmingham and Oxford Junction were purchased by the Great Western in 1848.

The Oxford, Worcester and Wolverhampton Railway—8 & 9 Vic., c. 1845—ran from the Great Western at Wolvercot, just north of Oxford, through Worcester, to the Grand Junction at Wolverhampton. The Act also provided for the absorption of the Stratford and Moreton Tramway—see article No. V. Under 11 & 12 Vic., c. 59, 1848, the junction with the Grand Junction was to be at Bushbury, and a jointly owned station was to be built at Wolverhampton. The original Act provided that the line was to be of such gauge as would allow it to be worked continuously with the Great Western. It was therefore necessary that from Oxford to Norton Junction—south-east of Worcester—where there was a junction with a branch from Abbott's Wood on the Birmingham and Gloucester section of the Midland, the line should be broad gauge, and thence to Wolverhampton of mixed gauge. But despite the wording of the Act, only the narrow gauge was laid throughout, and as a result the company, when its powers expired in 1855, laid itself open to penalties. Parliament, however, gave another four years for the mixed gauge to be provided, but before that period expired, the Great Western had dropped the broad gauge, and under 22 & 23 Vic., c. 72, 1859, the original Act was amended in that respect. The Oxford, Worcester and Wolverhampton Railway was amalgamated with two other railways as the West Midland in 1860, which, in turn, was incorporated in the Great Western in 1863.

Literature.

SHORT NOTICES.

Modern Power Engineering. By A. Regnauld. London: Caxton Publishing Company, Limited. 1924. Four volumes. Price £3 18s.—This is one of those books that it is a little difficult to classify. Possibly it is best described as a kind of encyclopædia of power engineering. We understand from the author, who is senior lecturer and superintendent of workshops at Faraday House Engineering College, that it has been expressly written for those "who have not had the advantage of an elementary scientific or technical education," and "it is hoped that it will appeal to the vast number of engineers who are engaged in the care and maintenance of power generating plant, but who have hitherto been debarred from understanding the why and the wherefore of the machinery in their charge because of their inability to understand the scientific and technical language usually found in engineering text-books." The object thus stated is an excellent one, and from a perusal of the four volumes we should say that the author has done his work well. The book is certainly one that the young engineer should have beside him to supplement his academic studies and to bring him face to face with the realities of power engineering. Mr. Regnault writes with an easy style, and his long experience of teaching has given him the knack of explaining mechanism and its *raison d'être* with clearness. We need say no more than that in the four volumes the whole subject of power engineering is covered, but that each volume can be taken independently of the others. Thus the first deals mainly with steam turbines, the second with internal combustion engines, the third with reciprocating engines and pumps, and the fourth with boiler plant of all descriptions. The re-drawn illustrations are, without exception, good, but many of the half-tone blocks show signs of exhaustion. Living in catalogues is a strenuous life. It is to be regretted that the volumes are not sold separately.

A Dictionary of Electrical Terms. By S. R. Roget. London: Isaac Pitman and Sons, Limited. 1924. 7s. 6d.—If there is anything in a name, this little dictionary is well ushered into the world. Everyone who puts pen to paper in more than a casual way knows that invaluable old friend, Roget's "Thesaurus," and if Mr. S. R. Roget is a descendant of that familiar author, he deserves our regard. We have looked through his little volume with some care and find his definitions accurate and concise. He claims that they represent the meanings of terms as commonly accepted, but he does not venture to say that they will conform precisely to the terms as they are now being standardised by the Electrotechnical Commission. That Commission will fix limits to definitions of greater accuracy than any now in use. But for the ordinary man, the definitions supplied by Mr. Roget will suffice, and as a dictionary for the table, his book may be heartily commended.

BOOKS RECEIVED.

Year Book of the Michigan College of Mines, 1923–1924, and Announcement of Courses, 1924–1925.

Loughborough College, Leicester: Calendar for the Session 1924 25. Loughborough: The *Echo* Press.

Distillation du Bois. By G. Dupont. Paris: Gauthier Villars and Cie., 55, Quai des Grands-Augustins. Price 25f.

The Greater Problems of Industry. By Alexander Ramsay. Birmingham: *Journal* Office, 31, Cannon-street. Price 3s. 6d. net.

Port of Rangoon: Administration Report of the Commissioners from April 1st, 1923, to March 31st, 1924. Rangoon: British Burma Press. 1924.

Kelly's Directories of the Engineers, Iron, Metal and Motor Trades, 1924. London: Kelly's Directories, Limited, 186, Strand, W.C. 2. Price 45s.

Handbook on Ball and Roller Bearings. By A. W. Macaulay. London: Sir Isaac Pitman and Sons, Parker-street, Kingsway, W.C. 2. Price 12s. 6d. net.

The Principle of Applied Electro-chemistry. By A. J. Allmand and H. J. T. Ellingham. Second edition. London: Edward Arnold and Co., 41–43, Maddox-street, W. 1. Price 35s. net.

Journal of the Iron and Steel Institute. No. I., 1924. Vol. CIX. London: The Offices of the Institute, 28, Victoria-street, S.W. 1, and E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1.

Electrical Design of Overhead Power Transmission Lines. By W. T. Taylor and R. E. Neale. London: Chapman and Hall, Limited, 11, Henrietta-street, Covent-garden, W.C. 2. Price 21s. net.

Iron and Steel Institute, Carnegie Scholarship Memoirs. Vol. XIII. Edited by G. C. Lloyd. London: E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1, and the Iron and Steel Institute, 28, Victoria-street, S.W. 1.

Motor Bodywork. The Design and Construction of Private, Commercial and Passenger Types. By Herbert J. Butler. London: W. R. Howell and Co., Bedford-row Chambers, Theobalds-road, W.C. 1. Price 50s. net.

Dominion Water Power Branch of the Canadian Department of the Interior: Water Resources Paper No. 40—Arctic and Western Hudson Bay Drainage in Alberta, Saskatchewan, Manitoba and Western Ontario during the Climatic Year 1921–22. Ottawa: F. A. Acland, printer to his Majesty the King. (To be obtained free of charge from the Director of Water Power, Ottawa, Canada.)

Machine Tool and Engineering Exhibition at Olympia.

No. VI.*

WOOD-WORKING MACHINERY.

ALTHOUGH only four of the well-known makers of wood-working machinery exhibited at the Machine Tool and Engineering Exhibition at Olympia, each of the firms concerned had a really extensive exhibit, and several of the types shown were distinctly new.

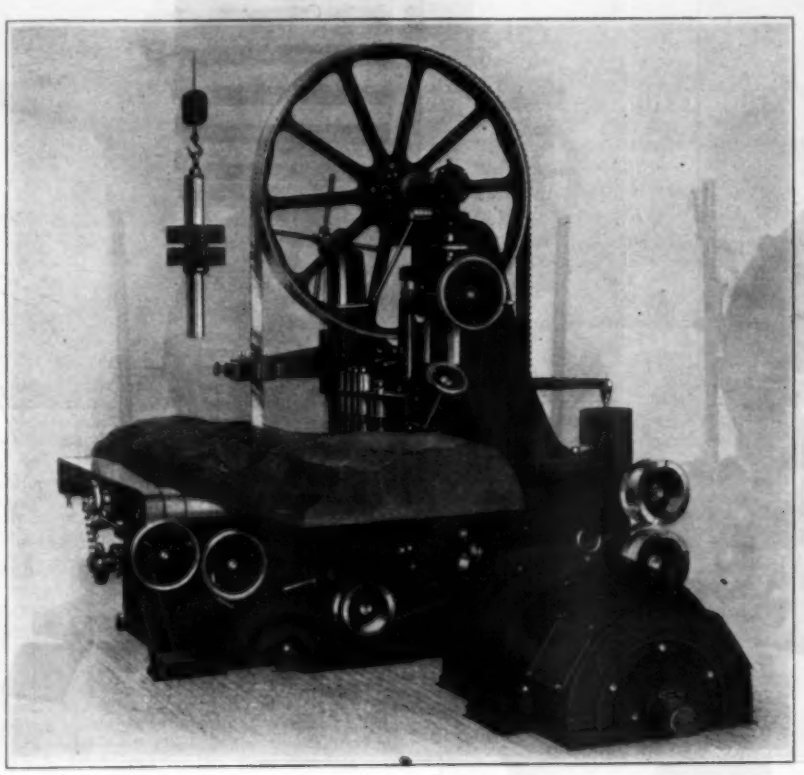


FIG. 75—HIGH-SPEED BAND RE-SAW, ADAPTED FOR CUTTING LOGS AND FLITCHES—ROBINSON

The four firms were:—Thomas Robinson and Son, Limited, of Rochdale; John McDowall and Sons, of Johnstone; Thomas White and Sons, Limited, of Paisley; and Wadkin and Co., Limited, of Leicester.

THOMAS ROBINSON AND SON, LIMITED.

This firm showed fifteen of its latest machines. Of them a high-speed band re-sawing machine was the most noticeable. This machine, which is illustrated by Figs. 75 and 76, is, as its name implies, primarily a high-speed "re-saw," though, as will be seen in Fig. 75, it may be used for occasional log and flitch sawing by the removal of the vertical feed rollers essential for re-sawing. When re-sawing a very powerful compound feed is used, as, in addition to the

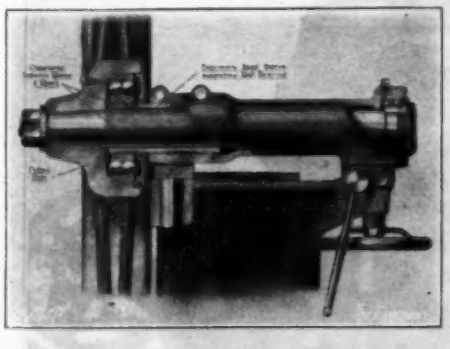


FIG. 76—METHOD OF MOUNTING BAND SAW PULLEYS ON THE ROBINSON RE-SAW

fluted vertical rollers, the propelling effort may be increased by smooth horizontal rollers, which project slightly above the table level immediately before and behind it. In each line of horizontal rollers, the centre and right-hand rollers are revolved for effecting the feed, and are immediately reversible, while the left-hand roller is free on its shaft, and is used for facilitating the return passage of the wood to the front of the saw for taking the next cut. The vertical and horizontal rollers may be used in conjunction or independently as the work may require.

The diameter of the saw pulleys is 60in., and they carry blades up to 7in. in width, and the machine will accommodate material, either round or squared, up to a maximum depth of 30in. One of the special features in this machine is the patented method of mounting the saw pulleys, which is shown by Fig. 76. In other makes of large band saws the practice is to support the pulley spindle by a bearing on both sides, because the great tension required in stretching these blades for work is apt to strain or spring the spindle, if there is a bearing on one side only. Messrs. Robinson overcome this difficulty by relieving the spindle of all tensile stress, as the whole of the tension occasioned by the stretching of the blade between the pulleys is supported by a fixed steel sleeve, which encircles the spindle, but is clear of it. The saw pulley, it will be noted, is supported directly under the centre of the rim by very large ball bearings. The inner ball race is carried on the stationary steel bush clear of the spindle, whilst the outer race is secured in the centre of the pulley boss, the outer boss of the pulley alone being secured to the spindle.

The rate of feed is instantly variable, while the blade is actually in the cut.

When used for log sawing, if the timber has been squared or quartered, or if it possesses only one flat side—as in Fig. 75—its weight upon the horizontal feed rollers suffices to propel it through the machine, but if round logs are to be sawn, a flat-bottomed cradle is used, which provides the necessary surface to enable the rollers to grip and propel it.

Messrs. Robinson also showed their latest plain band saw, a rapid circular re-saw, a two-spindle dimension saw bench and a rising and falling spindle bench, two four-side planing and moulding machines, a single-spindle vertical moulder for irregular work, and a panel planer, as well as a new heavy surfacing and thicknessing machine for railway vehicle and shipbuilding work. This machine may be fitted with either two or four spindles, and in the latter case it will "size" material on all four sides simultaneously up to 30in. wide by 7in. thick. It is fitted with the V belt variable feed. Another railway rolling stock machine was a heavy hollow chisel mortising machine, fitted with two canting boring spindles. There were also two other mortising machines on this stand, in one of which the hollow chisel is actuated automatically, thus relieving the operator of all hard work and enabling the hollow chisel machine to compete in speed with the popular chain mortiser. The machine has also a chain mortising attachment. Two tenoning machines and a Robinson "universal wood-worker" were also shown.

One of the most interesting items on this stand,

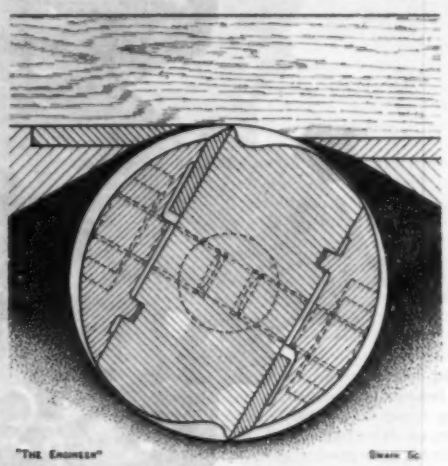


FIG. 77.—SAFETY CUTTER BLOCK WITH RELIEVED BACK

although it is a small one, was the new circular cutter block, of the "safety" type, which Messrs. Robinson now use on their hand feed and "over-and-under" planers. We illustrate it by Fig. 77, from which the shape of the block will be seen. The gap below the cutter provides the clearance for the chips to escape, but the "relieved back"—in other words, the deviation from the true circle immediately behind the cutter—has the double effect of creating a draught for the ready dispersing of the chips and of allowing ample space for "whetting" the cutters when in position. Furthermore, the "relieved back" creates a sucking action which tends to hold the wood down firmly on the table as it passes over the knives. The knives are so placed that they cut with a shearing instead of a chipping action.

JOHN MCDOWALL AND SONS.

This firm showed eight machines, but among them were none of the heavy log-sawing kind, for which

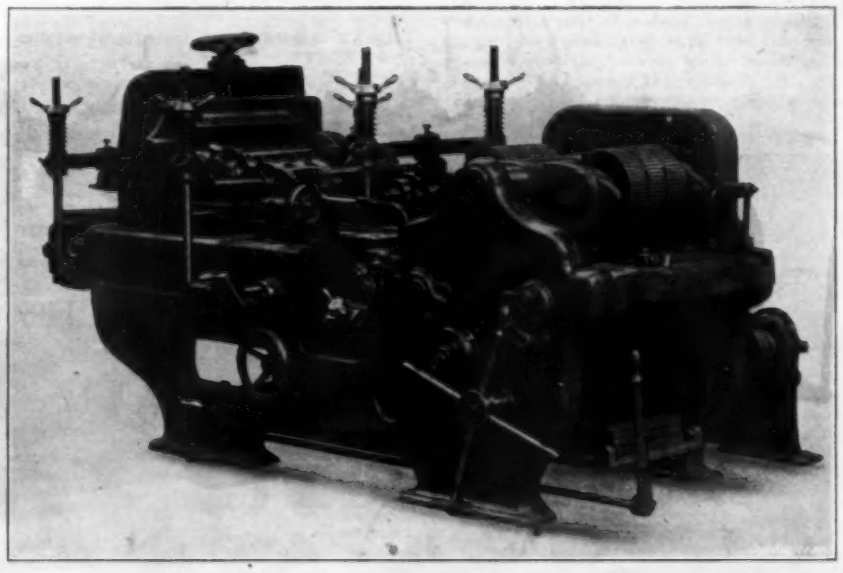


FIG. 78—FIVE-CUTTER MOULDING AND PLANING MACHINE—McDOWALL

the name of McDowall has so long been famous. The machines shown comprised a 12in. by 6in. five-cutter planing and moulding machine—which we illustrate by Fig. 78—two self-feeding saw benches, a hand feed planer, a tenoning machine for timber up to 16in. by 6in., a double-spindle irregular moulding machine, a portable electrical saw bench, and an automatic deck-caulking machine.

The lighter of the two self-feeding saw benches possesses an interesting feature, the merit of which is

* No. V. appeared October 3rd.

its extreme simplicity. In it all the complicated and cumbersome gear to which we are accustomed on the tables of power feed saws is abolished, and the material is propelled merely by a single toothed roller, or rather disc, the teeth of which only project slightly above the saw table. This toothed feeding disc can be adjusted for height so that the grip upon the material may be regulated, and it immediately precedes the saw blade. Over the disc is a self-adjusting pressure roller, which keeps the material firmly down on the teeth of the disc. When the surface of the propelling agent is so narrow as is the case here, for the thickness of the disc does not exceed that of the saw blade, the teeth of the disc must of necessity bite into the surface of the wood in order to ensure a constant feed without slip. This would be a disadvantage with a wider feed roller, but here this drawback is negatived by the fact that the feeding disc, being in perfect alignment with the blade, all the indentations it makes in the wood are within the line of the saw cut, and so are removed automatically as the sawing proceeds.

The most attractive machine on this stand, however, was the "Clyde" deck-caulking machine, which is self-contained with its motor, and travelled about the stand at the rate of 40ft. a minute, thumping the floor as it went at the rate of some eight blows to the foot of its progress. It is truly a marvellous implement.

This machine, which is shown by Figs. 79 and 80, weighs approximately a ton, weight being a desirable factor as giving efficiency to the stroke of the caulking hammer. A 3 brake horse-power reversible motor suffices both to propel it "fore and aft" on fluted rollers, which travel along the deck, and to work the hammer, which is reciprocated by a crank on a flywheel of the motor. Before and behind the hammer are the seam guide wheels, which are, in fact, free running tapered discs, which enter the seam to a certain depth and ensure that the caulker follows accurately the line of the seam. Immediately above the seam in the deck, and forming a part of the machine, is an "extended seam," or hollow tapered guideway, into which the oakum is fed by the action of the hammer itself, and through which the hammer strikes its blow, regulating its own supply of oakum, compressing it and thrusting it into the seam below always to the required depth and ensuring a uniform density of material. The depth to which the hammer strikes is regulated by a hand adjustment outside the gear case. The oakum is wound round a bobbin placed on the top of the casing, and when once threaded and with the guide wheels placed in the seam the machine is started and requires no attention until it has caulked automatically the entire length of the seam. The traversing gear for moving the machine laterally from one seam to another in either direction is operated by the hand levers shown. Before shifting, however, the machine is lifted bodily by means of a treadle, which at the same time brings into play under it wheels which revolve at right angles to the seam. This arrangement is clearly seen in Fig. 80. The face of the hammer is a few inches long and of a width suitable for the seam it is caulking. Backwards from the face, it tapers outwards to conform to the taper of the walls of the "extended seam" through which it strikes.

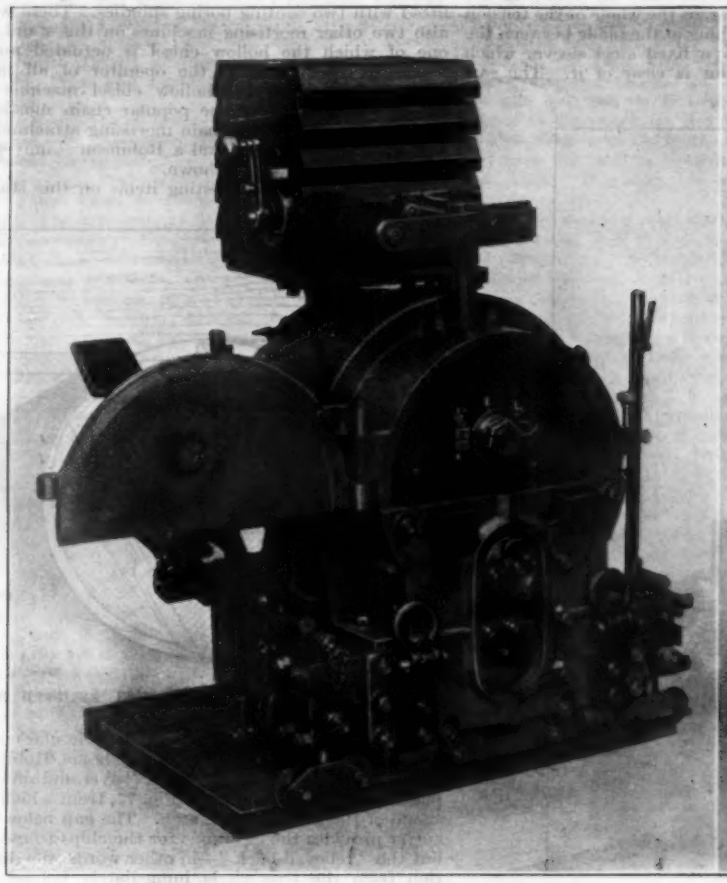


FIG. 79—AUTOMATIC DECK CAULKING MACHINE—McDOWALL

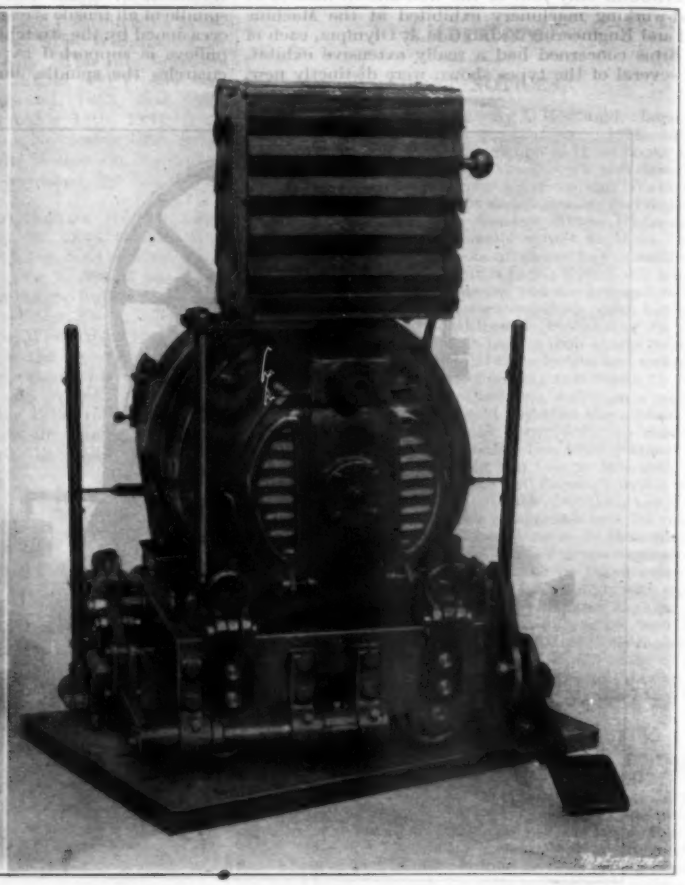


FIG. 80—DECK CAULKER RAISED FOR TRAVERSING FROM SEAM TO SEAM

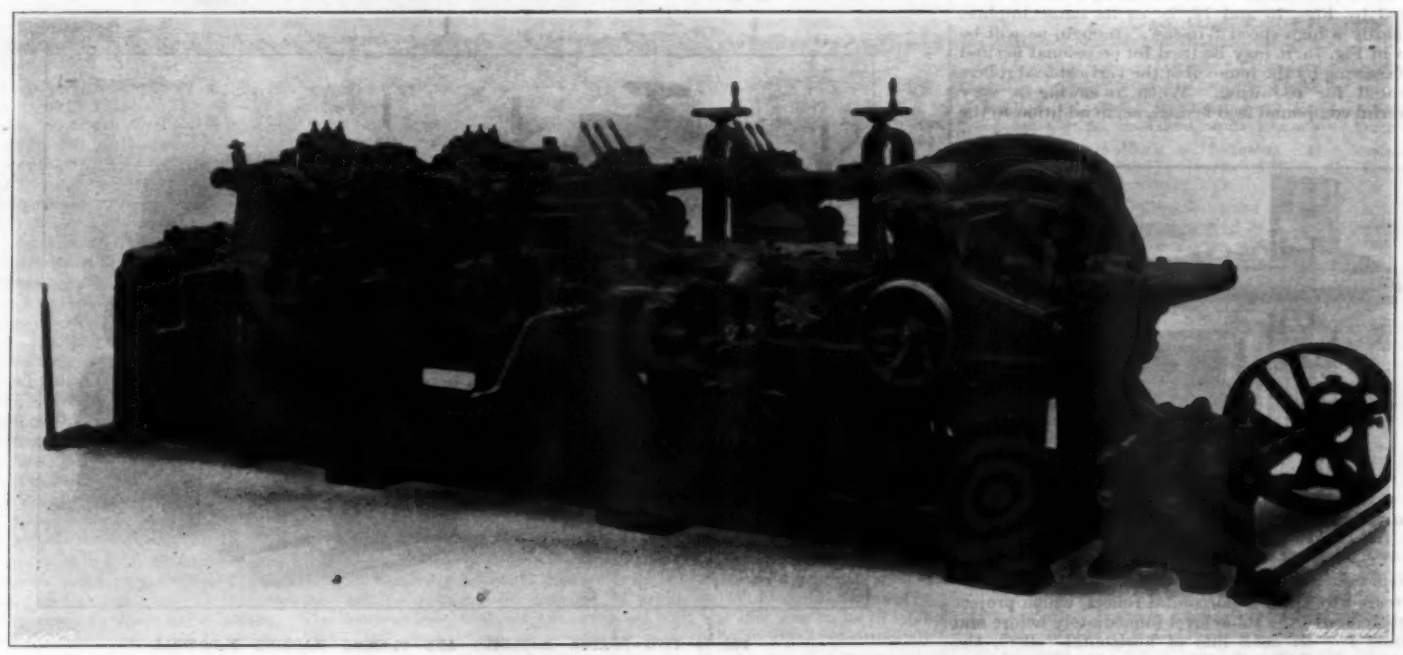


FIG. 81—PLANING, MOULDING AND MATCHING MACHINE—WHITE

This machine is capable of doing the work of twenty hand caulkers, and with a regularity that cannot possibly be attained by hand work. Moreover, if properly adjusted, it cannot "scamp" or "fake" the work.

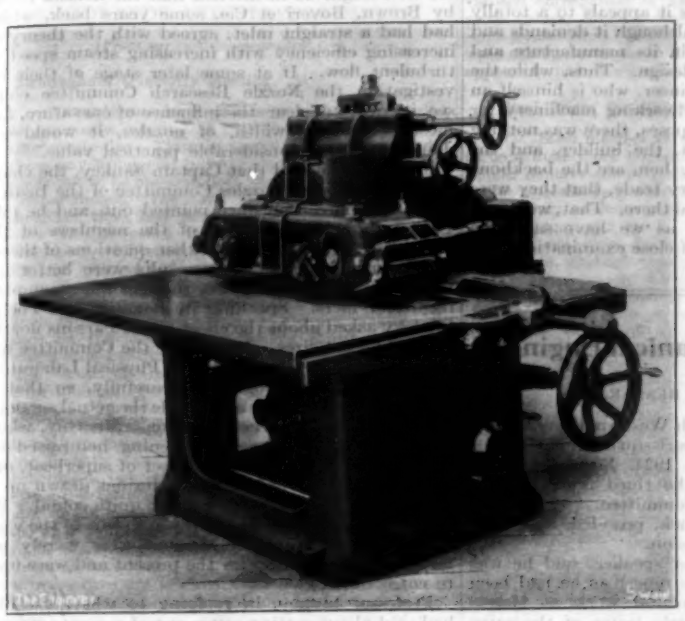


FIG. 82—STRAIGHT LINE EDGING SAW BENCH—WHITE

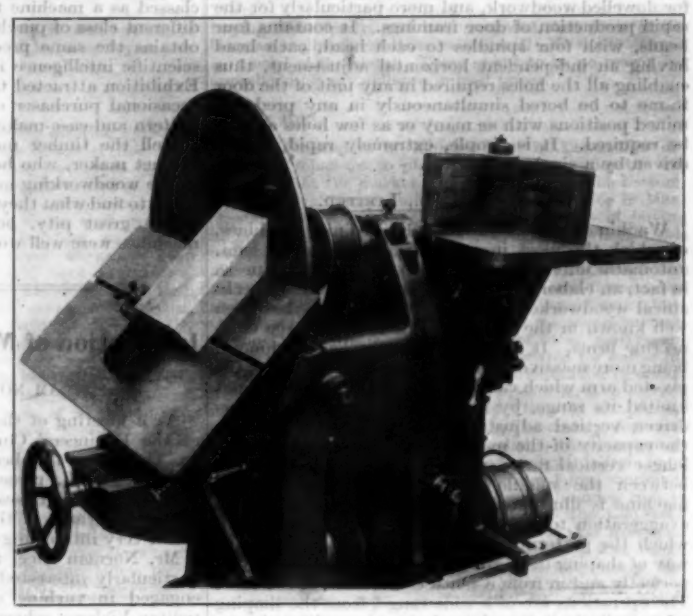


FIG. 83—COMBINED DISC AND SPINDLE SANDER—WADKIN

Thomas White and Sons, Limited.

This firm showed a dozen machines, including a planing, moulding and matching machine, a "straight-line" edging saw bench, a double drum sander, a panel planer, an over-and-under planer, a chain and hollow chisel mortising machine, a double-end tenoning machine, single and two-spindle irregular moulding machines, a multiple spindle horizontal borer, a vertical borer, and a dimension saw bench.

Most of the machines enumerated contain characteristic features, one of which is the unusually high spindle speeds advocated by this firm on certain of its machines. Another feature is the utilisation of the endless chain or "travelling table" friction feed for saws and sand-papering machines.

We illustrate by Fig. 81 Messrs. White's most recent planing, moulding and matching machine, which deals with material up to 9in. by 4in., and, instead of the usual variable speed gear, which on the very high-speed planers is altered progressively as and when required, it is fitted with a special gear box which permits of nine definite rates of feed to suit different classes of work. Another feature of this planer is that it is fitted with slip-on cutter blocks, which permit the removal of blunted cutters and their substitution by a new set, ready adjusted on another block, in a couple of minutes. The slip-on block has also the great advantage that the nature of the blocks used may be readily changed, thus rendering the machine very versatile.

Another interesting machine on this stand was a "straight-line edging" bench, in which the circular blade revolves on a spindle above the table and the material is fed underneath it by a revolving table or series of steel pads forming an endless chain. We believe that Thomas White and Sons, Limited, is the first British firm to undertake the manufacture of this particular type of saw bench, which we illustrate by Fig. 82; but machines on this principle, though of somewhat lighter build and with a less powerful feed, have been made and used successfully for some years in the United States. Unquestionably, this is the most rapid, efficient and easily worked type of saw bench for trimming the ragged edges of boards or for general edging with a single blade, and, as the straight line is guaranteed by the travel of the table on to which the wood is pressed by the top rollers, which are also driven, most of the skill which is required in doing this work on the ordinary push bench is avoided. A further advantage possessed by this machine is that, given a suitable saw blade properly maintained, boards can be jointed with so good an edge as to render unnecessary subsequent jointing on a planing machine.

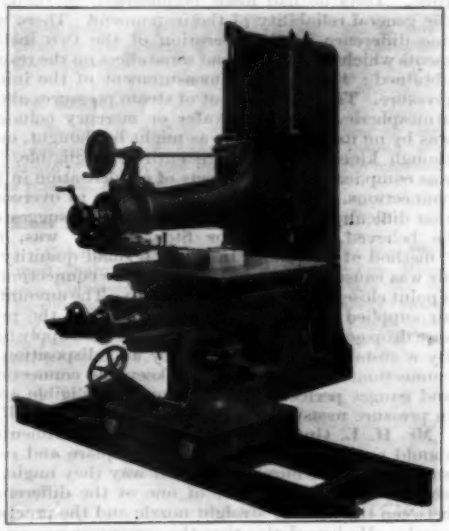


FIG. 84—SEMI-UNIVERSAL WOOD MILLER—WADKIN

In the double-drum sand papering machine shown by this firm the feed is also effected by a series of pads on an endless travelling chain. In this case, however, the pads are of rubber. The great advantage of the travelling chain feed over the roller feed is that very short stock can be treated, as there is no gap between rollers to be negotiated.

Fig. 85 shows a White double tenoning machine with one fixed and one adjustable, or travelling, tenoning head set on the same bed-plate. Each head is fitted with the usual spindles for cutting single and double tenons, scribing the shoulders and cross cutting to accurate lengths. There is virtually no limit to the length of the material to be tenoned at both ends simultaneously, but the machine shown accommodates pieces up to 6ft. 6in. between the shoulders of the tenons. The feature which chiefly differentiates this machine from other self-feeding double-end tenoners is that, in addition to the ordinary travelling dog chains on which the wood is placed and which carry it through the machines, it possesses travelling "top pressures" for holding the wood in position while it is being tenoned, instead of the ordinary stationary pressures. These travelling pressures consist of a pair of endless chains lying horizontally above the work and supported on free pulleys, round which they travel when the wood comes in contact with them. This contact with the wood is taken by the rubber pads on the chain, and these travel with the wood as it is propelled by the feed gear. Thus there is no rubbing or marking of the wood, and it is firmly gripped

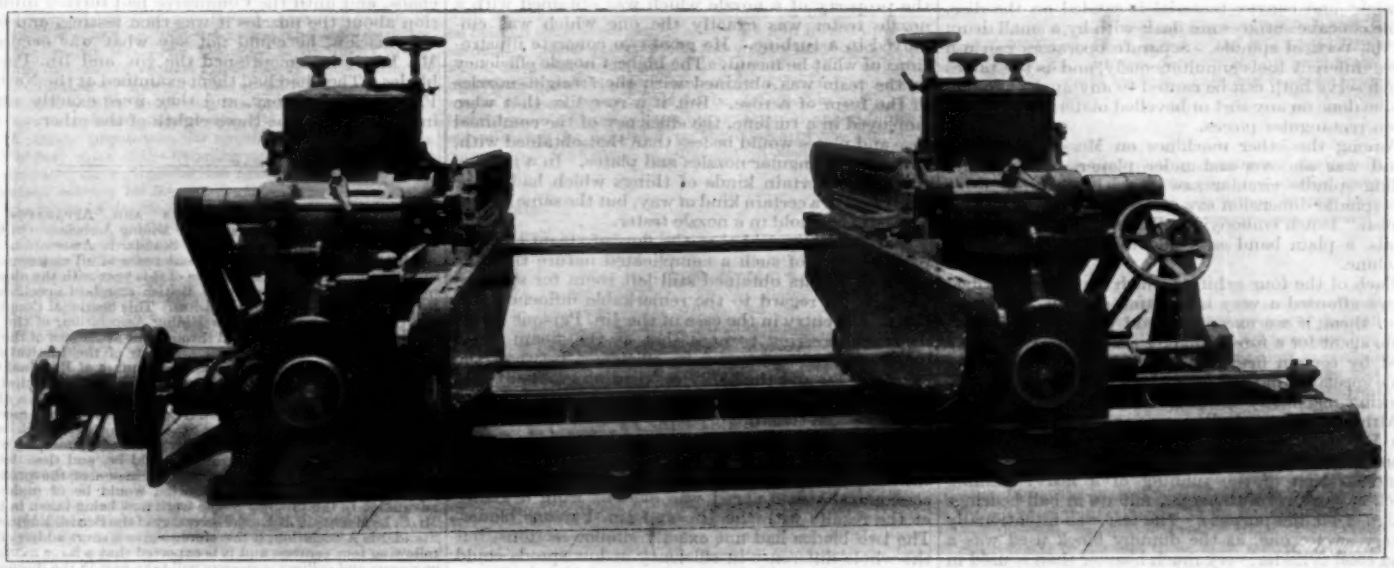


FIG. 85—DOUBLE-END TENONING MACHINE WITH TRAVELLING TOP PRESSURES—WHITE

throughout its entire passage through the machine.

A multiple boring spindle machine which was seen on this stand is also a notable tool. It has been especially designed for meeting the growing demand for dowelled woodwork, and more particularly for the rapid production of door framings. It contains four heads, with four spindles to each head, each head having an independent horizontal adjustment, thus enabling all the holes required in any unit of the door frame to be bored simultaneously in any predetermined positions with as many or as few holes as may be required. It is simple, extremely rapid, and is driven by a single belt.

Wadkin and Co., Limited.

Wadkin and Co., Limited, exhibited nine machines, of which the most imposing was their new "semi-automatic universal wood miller." This machine is, in fact, an elaboration of the firm's "universal mechanical woodworker," which for many years has been well known in the pattern shops of most large engineering firms. It differs from the earlier machine in being more massive in build and in the replacing of the pivoted arm which carried the spindle, and somewhat limited its range, by a horizontal arm with power-driven vertical adjustment which greatly increases the capacity of the machine by giving the spindle a longer vertical range, permitting a distance of 30in. between the spindle clutch and the table. The machine is illustrated by Fig. 84. It is hardly an exaggeration to say that there is no intricate work which the patternmaker is called upon to do in the way of shaping his material that it cannot effect more perfectly and in from a tenth to a fiftieth of the time. The operations are of a wide range, from the shaping out of all the internal work in a complicated core box to the elaborate fashioning of patterns for helical and other gear wheels, the cutting of spiral threads and recessing, shaping and tracery work to any design.

Although massive in build and necessarily containing a great number of adjustments, the Wadkin wood miller is, in effect, an extremely simple machine to work and adjust when the operator has once mastered its niceties. It must be admitted, however, that the degree of its efficiency depends less upon the skill than upon the experience, aptitude and intelligence of the operator. All the adjustments are easily and very rapidly made and accuracy is assured by a full range of indicators, gauges and stops. The vertical range of the horizontal arm which carries the spindle is effected by means of a screw and slides on the standard of the machine and is power driven. The angle of the spindle is regulated by pivoting the spindle head and locking it in the required position. The spindle is also instantaneously reversible. The table, too, is fitted with every conceivable adjustment, both vertical and horizontal, and it also pivots on its centre and can be traversed bodily on rails to either side of the machine. There is every facility for rapidly centring the material on the table or for fixing it in any other position that may be required, and it is this complete and easy adaptability of the relative positions of the table and the reversible spindle which permits of this great variety of work.

Somewhat akin to the above machine, in that it will perform some, though by no means all, of the same operations, is the high-speed boring, recessing, housing and stair stringing machine, which is a very simple tool with an overhead vertical spindle, and may be described colloquially as the top half of the old-fashioned and cumbersome "elephant" moulder, which it is largely superseding.

Another machine which is essentially a patternmaker's tool is the Wadkin combined disc and vertical spindle sander, which is illustrated by Fig. 83. Straight and convex material is sanded on the disc, while concave surfaces are dealt with by a small drum on the vertical spindle. Separate operators can use these different tools simultaneously, and as the tables which serve both can be canted to any angle, sanding can be done on any sort of bevelled material as readily as on rectangular pieces.

Among the other machines on Messrs. Wadkin's stand was an over-and-under planer, a rising and falling spindle circular saw bench, a canting table two-spindle dimension saw, a recently designed plain "push" bench embodying all the latest Home Office ideals, a plain band saw, and a belt sand papering machine.

Each of the four exhibits which we have described above afforded a very interesting display, but apart from them, if we except an odd machine shown by some agent for a foreign maker and one or two others used by certain firms to demonstrate the action of some speciality of their own, there was no other woodworking machinery at this Exhibition.

Although Messrs. A. Ransome and Co. did not show, the Ransome and Marles Bearing Co., also of the Stanley Works, Newark-on-Trent, gave an interesting demonstration of the running of a heavy planing block at 5000 revolutions per minute in ball bearings designed for the purpose. The test was intentionally a very severe one, as the dummy block used was a solid steel cylinder, very much heavier than is used in practice, and the speed at which it was run was from 25 to 30 per cent. higher than the accepted normal speed for such work, even when it is a question of modern high-speed planing.

The absence of so many of the other well-known makers whom one would have expected to see is to be attributed to the fact that there was nothing in the title of this Exhibition to indicate that woodworking machinery was to be seen. A woodworking machine can by no stretch of the imagination be classed as a machine tool, as it appeals to a totally different class of purchaser, although it demands and obtains the same precision in its manufacture and scientific intelligence in its design. Thus, while the Exhibition attracted the engineer, who is himself an occasional purchaser of woodworking machinery for pattern and case-making purposes, there was nothing to tell the timber merchant, the builder, and the cabinet maker, who between them are the backbone of the woodworking machinery trade, that they were likely to find what they wanted there. That, we think, was a great pity, because, as we have said, the machines were well worthy of close examination.

Institution of Mechanical Engineers

STEAM NOZZLES RESEARCH.

At a meeting of the North-Western Branch, held at the Engineers' Club, Albert-square, Manchester, on Thursday, October 2nd, 1924, Professor G. G. Stoney, F.R.S., presented the third report of the Steam Nozzles Research Committee. Mr. Alfred Saxon, chairman of the branch, presided, and there was a very interesting discussion.

Mr. Norman Elce, the first speaker, said he was particularly interested in the report as he had been engaged in turbine experimental work at Metropolitan-Vickers, where a nozzle tester of the same type as the one under discussion was used. Above about 700ft. per second the results of his tests were generally of the same order as those shown. Below that velocity there were differences which were the subject of investigations in progress at the present time. Tests he had made emphasised, he thought, the general reliability of the instrument. There was one difference in the operation of the two instruments which might have had some effect on the results obtained; that was the measurement of the initial pressure. The measurement of steam pressures above atmospheric, even with water or mercury columns, was by no means so simple as might be thought, even though kinetic effects were entirely negligible. It was complicated by the effects of condensation in the connections. He had found it possible to overcome that difficulty completely by a method first suggested, he believed, by Professor Stoney, that was, the "method of air leaks," in which a small quantity of air was caused to flow into the pressure connection at a point close to the source of pressure. The amount of air supplied was controlled by controlling the pressure drop across a capillary tube in the air supply line. By a suitable choice of capillary and disposition of connections, it was possible to keep the connections and gauges perfectly dry with quite negligible error in pressure measurement due to the air flow itself.

Mr. H. L. Guy suggested that the experimenters should carry out experiments with square and rectangular straight nozzles. In that way they might be able to observe the effect of one of the differences between the ideal or straight nozzle and the practical nozzle. He hoped also that the experimenters would find it possible to carry out further experiments on the effect of superheat. He would like to stress one of the points that Mr. Elce had raised, and that was that caution must be exercised in interpreting the results obtained and applying them directly to practice, because it was not quite certain at the moment that the property of a nozzle which was obtained with a nozzle tester was exactly the one which was employed in a turbine. He gave two concrete illustrations of what he meant. The highest nozzle efficiency in the tests was obtained with the straight nozzles in the form of a rose. But if a rose like that were employed in a turbine, the efficiency of the combined rose and plates would be less than that obtained with, say, the rectangular nozzles and plates. In a turbine there were certain kinds of things which had to be employed in a certain kind of way, but the same limitations did not hold in a nozzle tester.

Mr. M. Konig said that the flow of steam through passages was of such a complicated nature that the valuable results obtained still left room for speculation. With regard to the remarkable influence of a bad nozzle entry in the case of the ¾in. Parsons blade, it was interesting to note that as the steam speed increased, the difference in efficiency between the correctly set and the badly set blading gradually disappeared. That was evidently due to the fact that at higher speeds the kinetic energy produced in the inlet portion became a smaller fraction of the whole energy converted. How far the width, or, in other words, the curvature might influence the value of the most economical steam speed was evident from a glance at the results with the ¾in. and 1in. Parsons blades. The two blades had not exactly similar sections, but the whole difference in efficiency at low speeds could not be attributed to that, but was caused by the bigger curvature losses of the smaller blade. Thus, for example, a steam speed of 600ft. per second would be more efficiently utilised with 1in. width Parsons blade than the lower speed of 400ft. per second with a ¾in. guide blade. It was also very likely that it was that influence of the curvature which caused the difference in performance between Mellanby's nozzle and the other types at higher speeds. As evidence for that might be mentioned that the nozzles tested by Brown, Boveri et Cie. some years back, which had had a straight inlet, agreed with the theory of increasing efficiency with increasing steam speed at turbulent flow. If at some later stage of their investigation the Nozzle Research Committee could see its way to clear the influence of curvature, *i.e.*, most economical width, of nozzles, it would undoubtedly be of considerable practical value.

Mr. T. Petrie said that Captain Sankey, the chairman of the Steam Nozzles Committee of the Institution, had more than once pointed out, and he (Mr. Petrie) thought that most of the members of the Committee agreed with him, that questions of theory and interpretation of their results were better left until they had got what they thought was a complete record of facts. Speaking in London, Mr. Pochobradsky asked about the effect of the Parsons nozzles being different sizes. As a result the Committee had sent the sections to the National Physical Laboratory and had them photographed carefully, so that it could find out as nearly as possible the actual sections. It hoped to publish them later on. Mr. Guy, whom he was glad to see there that evening, had raised one or two points. One was the effect of superheat, and he had said that one of the conclusions drawn up in the third report was perhaps not quite sound. Mr. Petrie said that as far as the research side of the work was concerned, those conclusions were merely put forward as suggestions for the present and were open to correction.

Professor Stoney, in replying to what Mr. Elce had said about getting water out of pressure gauges, mentioned that he had tried some experiments at the College of Technology. He had put on a pipe flow and pumped in quite a small quantity of air at about 2in. or 3in. per minute, and he had found that water in that pipe was completely avoided. Mr. Elce had developed that plan further, so that a definite quantity of air could be obtained. Professor Stoney thought that that method would have to be used in every case in which one wanted to get really accurate pressure readings. The experimenters had been working all through with mercury gauges. They hoped to go to higher pressures. The apparatus was constructed for 60 lb. to 70 lb. back pressure, and they hoped to go higher than that. They would then come up against the problem of measuring those pressures accurately. The ordinary pressure gauge was most unsatisfactory. Moderate pressures could be measured with mercury, but the ordinary pressure gauge was unreliable to something like 1 or 2 per cent. That was one of the serious problems that would have to be considered. Mr. Guy had mentioned testing square and rectangular straight nozzles. He thought that was a most valuable suggestion, and that they would try to put it into practice. They would see what difference there would be between square and rectangular straight nozzles and the circular nozzles. He thought Mr. Guy's suggestion that divergence of the steam flow from $\frac{\sin - 1}{p}$ was a measure of the inefficiency was a most valuable one, and he wanted to look further into it. Referring to Mr. Konig's contribution, he admitted that there was certainly something mysterious occurring somewhere about 600ft. to 800ft. per second in their nozzles, which was not accounted for by Osborne Reynolds' theory. What it was he did not know. The Committee was trying to collect evidence about it, and see what could be done. The whole thing was in a state of chaos, and until the Committee had further information about the nozzles it was then testing, and other information, he could not say what was occurring. Mr. Petrie had mentioned the ¾in. and 1in. Parsons blades. They had had them examined at the National Physical Laboratory, and they were exactly similar in shape. One was three-eighth of the other.

British Standard Materials and Apparatus for Collieries.—At the request of the Mining Association of Great Britain, the British Engineering Standards Association, as a result of a fully representative conference of all concerned, set up a Sectional Committee in June of this year with the object of preparing a limited number of British standard specifications for colliery materials and requisites. This Sectional Committee has the fullest support of the Mining Association, of the local Coalowners' Associations, and through the assistance of the local Coalowners' Associations local branches of the Institution of Mining Engineers and other bodies a number of Regional Committees in the larger coalfields have been set up in order that local practice may receive full and complete consideration in all the work undertaken by the Sectional Committee. At the meetings of the Regional Committees it was felt that the work of the British Engineering Standards Association was not as widely known in the coal industry as it should be, and that detailed information of its work and some discussion of the principles underlying industrial standardisation would be of undoubted advantage to the progress of the work now being taken in hand. Mr. C. Le Maistre, C.B.E., the secretary of the British Engineering Standards Association, is therefore to give a short address in the following four centres, and it is expected that a large number of engineers and colliery managers will take part in the discussion:—Manchester, Geological and Mining Society, 5, John Dalton-street, Manchester: 4 p.m., Tuesday, October 14th; South Wales Institution of Engineers, Park-place, Cardiff: 2.30 p.m., Thursday, October 16th; Mining Institute of Scotland, Royal Technical College, Glasgow: 2.30 p.m., Saturday, October 25th; North of England Institute of Mining Engineers, Neville Hall Newcastle-on-Tyne: 3 p.m., November 6th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Birmingham Quarterly Meeting.

There was a large and representative gathering at the quarterly meeting of the Midland iron trade in Birmingham to-day—Thursday—and though business did not show any wonderful improvement, there was a little more activity to be noted in both the raw iron and finished steel departments. The tone of the market generally was brighter than had been anticipated and than has been the case in recent weeks. Iron and steel masters and engineers, it would appear from conversation on 'Change, are inclined to the opinion that the third quarter of the year 1924 holds prospects of better business than the quarter just ended. It was stated that several Birmingham industries are improving and are making fair demands on the steel trade. Among those mentioned were the motor building industry, bedstead manufacture and the electrical trade. Some very good orders for hoops for the making of conduit tubes have quite recently been placed with re-rolling mills in this district. The interest of the gathering to-day was focussed chiefly on the pig iron situation as affected by the recent reduction in furnace coke values. It was recognised that the difficulty in which the blast-furnaces have been for some months past might be ameliorated by applying this abatement in coke to the wiping out of the adverse balance on pig iron production. The furnaces, however, cannot be made to pay without a much larger consumptive demand, and that is not considered likely to accrue unless iron prices are lowered. Further, it is recognised that this larger consumptive demand might or might not result from a general lowering of the prices of iron and steel. It is more or less a matter of conjecture. In many quarters it was considered that buyers of pig iron will do well not to push unduly the advantage which superabundance of stocks and the altered position regarding coke seem to give them. As a result of pressure they to-day secured a reduction of from 2s. to 3s. per ton in forge and foundry iron prices, and they should, it is thought, be content. Those makers who are engaged in other branches of the iron and steel trade should reflect that a sudden break in raw iron prices could hardly fail to have quick reactions on other departments of the market.

Fall in Pig Iron Prices.

In spite of the facts that Midland blast-furnacemen strongly opposed the claim that pig iron consumers should participate in the saving effected by the reduction in blast-furnace coke values, and that profit on pig iron production has already disappeared, circumstances were such that smelters at the quarterly meeting were compelled to reduce their quotations. The fall in values ranges from 2s. to 3s. per ton, but even so it was insufficient to meet the ideas of some buyers. Northamptonshire forge iron sold at £3 12s. 6d. to £3 13s., and No. 3 foundry at £3 18s. to £3 19s. Derbyshire forge made £3 18s. to £3 19s., and foundry about £4 2s. 6d. North Staffordshire brands were quoted forge £4 and foundry £4 5s. Buyers still held off for lower prices, and what business was done was for immediate requirements. Confidence is insufficient, in the estimation of users of pig iron, to justify forward contracting. There seems to be little doubt but that, heavy as have been the sacrifices made by the industry during the slump through which the trade has been passing since the spring, further sacrifices will have to be faced before the iron trade can be re-established.

Competition in Bar Iron.

The finished iron trade of the district continues apathetic, though the position is perhaps hardly so gloomy as it has been. A fairly good demand for marked bars is maintained at the basis price of £15. Crown quality iron is only in moderate request, and the price shading already reported continues. The full extent of the "cut" is about 5s. per ton. Nut and bolt bars are very little called for. The industry is decidedly quiet and some increase of capacity has taken place owing to the introduction of more powerful and efficient plant. For the comparative small requirements of the trade the works have ample supplies of material bought some time ago. A large proportion is of foreign origin. As a matter of fact, most of the finishing mills in this district are being operated on continental raw material. The material in question cannot be bought from native sources at a price which would enable the manufacturer of the finished article to hold the market. Bar iron such as is used in the manufacture of bolts and nuts is quoted by Staffordshire and Lancashire makers at £12 per ton. They say they cannot produce it to sell at a less price than that if they are to get even a modest profit on the transaction. Meanwhile, Belgian bars have been offered for weeks past at prices ranging from £8 2s. 6d. to £8 5s. delivered in the Black Country. On 'Change to-day it was reported that Belgian ironmakers were further pressing sales, and that they had reduced prices to £7 15s., a concession of about 7s. 6d. per ton. This great difference in price rules out native bars for a very considerable range of work.

Ironworkers' Wages Advance.

As the result of the usual investigation of prices by the Midland Iron and Steel Wages Board for July and August, an advance of 2½ per cent. in ironworkers' wages took effect on Monday and will remain in force until December 6th. Wages have steadily advanced during the year, 5 per cent. having been awarded in April, 2½ per cent. in July, and 2½ per cent. in August, the aggregate effect being a considerable increase in the cost of producing finished iron. The latest advance brings puddlers' wages up to 67½ per cent. above the basis rate of 13s. 6d.

Galvanised Sheet Values.

The galvanised sheet trade, although rather quiet as regards new business, is well employed. Galvanised corrugateds of 24-gauge are a little weaker in price values, ranging from £18 to £18 5s. Last week some houses were quoting down to £18 2s. 6d., but others were asking as much as £18 10s. This latter figure now appears to have been withdrawn.

Steel Prices Maintained.

Steel masters at the quarterly meeting appeared to be a little more hopeful as to the future of their particular department of trade than they have been of late. As far as could be gathered the brighter tone was attributable mainly to some good contracts having been placed for constructional steel. Some of these were overdue, having been kept back by the building strike, but they have enabled many large steel works to keep in operation, which otherwise would have shut down. Competition in all classes of steel material is so keen that, except where price control arrangements exist, individual producers can only hold their own by making frequent departures from the regular quotations. In Birmingham to-day strong pressure was brought to bear by constructional engineers to bring down the price of joists and sections to £9, but so far as can be ascertained quotations remain on the basis of £9 10s. to £10, though some makers are said to have accepted £9 5s. At this figure the native producers are severely undersold by Belgium. Offers are also coming from Germany, but the reimposition of the 26 per cent. duty, and the general uncertainty of international affairs, militates against business with Germany. Moreover, many engineers prefer British steel, even at the higher price. Foreign competition continues the most troublesome element in the semi-finished steel department, Belgian billets being offered here at £6 5s. delivered, against the native price of £7 10s. Though a few firms are said to have accepted £7 7s. 6d. for mild steel billets, home makers generally are not disposed to make further concessions, on the ground that, as they state, the present selling figure does not cover the cost of production. Producers of high carbon billets are under increasing pressure owing to the diversion of business through the strike at Sheffield. Rates are unchanged at £9, £9 10s., and £10, according to carbon content. There is increased competition in cold rolled strip. A good trade is being done in small steel strip for the making of conduit tubes in connection with electrical supply.

Steel Scrap.

Merchants find it difficult to dispose of steel scrap, even at the low figure of £3 10s. delivered, and holders are more than ever inclined to retain the material, where possible, pending higher prices.

Mines Drainage Appointment.

Colonel J. W. Garratt, of Dudley, has been appointed chairman of the South Staffordshire Mines Drainage Commission in succession to the late Mr. G. Macpherson, who held the position for twenty years. The new chairman became a member of the Commission sixteen years ago, succeeding his father, Alderman Job Garratt, who was a member for twenty-eight years.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

The markets here for both ferrous and non-ferrous metals are quiet and dull, but the iron and steel trades are very much worse off for business than the copper, tin and lead markets. There is always some hope for the latter, but in the former, hope seems to have died out. The uncertain political situation is now having a bad effect, for it is fairly certain that if the country is to be afflicted with another General Election, almost all business must be held up until it is over. Politics are now mixed up with trade and markets very much more than they used to be when no questions of Free Trade or Protection entered into them; and in the present state of the iron and steel trades of this country, it is fairly certain that some protective measures against the importation of cheap foreign material will be discussed in the course of the political campaign. This alone is sufficient to keep the markets unsettled.

Metals.

The general condition of the non-ferrous metals here is not very much altered. In spite of the comparatively low prices for copper, there is a curious lack of confidence in the markets. In the non-ferrous group, copper is the only metal which can be called cheap; spelter, of course, is not dear, but it is not low in the sense that copper is low. For instance, a normal relationship between copper and lead is one to four; whereas the present relationship is barely one to two. Nevertheless, one cannot at present see much prospect for any serious advance in copper prices, and the probability is that too much copper is still being produced in proportion to the needs of the world. The attempt to reduce the output of copper with a view to bringing about a better relationship between production and consumption, does not seem to have been carried out with any vigour or with unanimity, and just now the tendency is rather towards increase rather than the reverse. Some producers evidently have tempting profits, even at the present comparatively low prices, and they do not care to forego them in the general interests of the market. The prices quoted for manufactured material are still rather high when considered in relation to the market rates for raw copper, spelter, &c. Tin is still a very nervous market, and prices here have jumped about a good deal. There seems to be a growing opinion that the recent "bear raid" on the London market was overdone, and that the price of the metal here is more likely to go to £250 again than to fall towards £200. Consumers, however, are contented to buy from hand to mouth rather than to take any risks. Both lead and spelter have kept remarkably steady for some time. There is a good supply of lead, but the Continent has been buying more freely, and it is supposed that some of the German buying is on Russian account. No doubt Russia is in need of the metal. There seems to be no reason for apprehending any collapse in lead prices.

Pig Iron.

Consumers of foundry iron in Lancashire are still very reluctant to place orders, being under the impression that the market is not yet down at the bottom. It was thought last month that when the price in Manchester reached 90s. per ton, a large amount of buying might be seen; but one begins now to doubt whether this was a true forecast. Although all sellers of No. 3 foundry iron in Manchester are not yet prepared to accept 90s. delivered, the market price is not far off that figure; but so far one does not see any widespread disposition to buy. Of course, it has to be remembered that the actual business of the Lancashire ironfoundries is not in an active condition just now. There is keen competition for orders for castings, and it is important for the ironfounder to obtain his material at the lowest possible price if he is to succeed in this competition. Apparently there is at present no apprehension of any advance in the costs; and until that apprehension arises, it is probable that consumers will continue their policy of buying foundry iron from hand to mouth. The sagging of the Cleveland iron market is another reason for delay in purchasing foundry iron in Manchester. Some consumers think that the Cleveland prices will soon be low enough to allow of that iron competing with Derbyshire in Manchester; but that would mean that Cleveland must fall considerably below 80s. The makers in Derbyshire iron do not yet admit that they can produce foundry iron at less than 82s. 6d. on trucks; but they labour under the disadvantage of very low prices for any forge iron that is made, whereas in the Cleveland district forge qualities are not much cheaper than foundry qualities. In any case, large buying of pig iron here is likely to be postponed for the present; and this tends to keep the market very quiet and dull.

Finished Material.

There is only a very little interest taken here in the markets for manufactured iron and steel. Actual business is reduced to a minimum, and although it would seem that prices cannot be forced down any lower, there is no idea of any probable change for the better. Rather more competition from abroad is reported from Scotland, but here people do not seem to be tempted by the low continental prices. The nominal prices for British steel remain at £9 7s. 6d. for joists and angles, £10 2s. 6d. for common plates, £10 for flat bars, and £10 5s. to £10 10s. for round bars. Prices for foreign steel may be reckoned as from 40s. to 50s. per ton below these prices.

Scrap.

Very little business is now being done, either in steel, cast or wrought scrap. Probably steel scrap is in the most depressed condition, but all kinds are depressed. About 60s. on trucks in Lancashire is still talked of for heavy steel melting scrap, but there is no immediate market for it. For heavy wrought iron scrap the prices are variable; it is said that 80s. delivered is all that some firms will pay, but probably 85s. is nearer the real price. Cast scrap is weak in sympathy with pig iron, and 85s. is freely quoted for good lots of broken machinery. Perhaps a little more might be obtained for "textile" scrap.

BARROW-IN-FURNESS.

Hematite.

There is no alteration in the hematite pig iron trade. The market continues to be very quiet, despite the fall in price a week or two ago. Customers continue to send small orders, and are not a bit inclined to order heavy tonnage or place orders for forward delivery. The fact that the rail mills are idle at Barrow is effecting the consumption of iron, and there is a fear that in consequence the furnaces at Barrow may have to be damped down. At present they are still at work, and it is hoped that they may remain so, but the outlook is not bright by any means. The oversea trade is small, and business in special qualities is not active.

Iron Ore.

The iron ore trade is simply a reflection of the pig iron trade, and until the pig iron market improves there is no hope for better conditions in the iron ore trade. Foreign ores—Spanish mostly—are coming in in restricted quantities.

Steel.

The steel trade so far as rails are concerned continues to be very quiet, and there is no sign of the mills restarting at Barrow at the moment. There are but few orders in the market, and the competition is exceedingly keen, especially from the Continent. A better state of things obtains in the hoop and small section departments, which continue to receive orders.

Barrow's Power Scheme.

The Barrow Corporation has at last decided to develop the water power scheme on the river Leven, which is the outlet of Windermere. About 3 miles after the river leaves the lake there is a series of falls at Backbarrow. It is proposed to harness these falls, and to obtain power for supplying electricity to Barrow and the surrounding district. At present there are two dams at Backbarrow. The first feeds a head race which supplies water power for the generating of electricity for an ultramarine works, and the second for the charcoal iron-smelting plant. The Barrow Corporation proposes to utilise the head-race from the first dam and extend it to a point beyond the

second dam. That will provide a fall of 33ft., and it is proposed to install three water turbines, each capable of driving generators of 500 kilowatts capacity. The proposed station would be linked up with the existing power station at Barrow, which has a capacity of 7000 kilowatts.

Shipbuilding and Engineering.

Vickers are concentrating on the completion of the big Orient liner Orama, which they expect to have ready for trials about the second week of this month. This 19½-knot Australian passenger ship presents a fine appearance at the fitting-out wharf, and will prove a great and important addition to the Orient fleet. A sister ship is being built on the stocks. A Donaldson liner will be launched early this month, and the London County Council barges are almost ready to come off. Engineering at Vickers' works is brisk and good progress is being made with the many important contracts held.

SHEFFIELD.

(From our own Correspondent.)

Condition of the Steel Trade.

No useful purpose would be served by writing a long story about the heavy steel trade of this district, as things are just as they were last week, which is another way of saying that they are very bad. The strike at three of the largest works continues, but the situation is not without hope, as the men are balloting this week as to whether they shall resume work, accepting certain terms offered by the employers and leaving other matters to be settled by negotiation. It is thought that the result of the ballot is likely to be favourable to resumption. In the finished steel departments, there is no improvement to report. The fact that the upward movement in high-grade steels has received a check is confirmed by the experience of the past week. For both tool steels and engineers' small tools the demand is quietor to-day than at any former period of this year. While there are many home orders for finished steel, the bulk of them are for very small quantities, and are hardly worth executing from the point of view of profit.

Cost of Production too High.

Mr. W. W. Wood, who was installed as Master Cutler on Tuesday, spoke very seriously on the state of trade, dwelling particularly on the necessity of regaining our export trade and on the handicap of foreign competition. He attributed the present state of things to high cost of production, and found that that, in its turn, was largely due to taxation. "At present," he said, "the steel maker is having a very difficult time. I do not know what he has done to deserve it. He has modernised his plant, increased his capacity, and improved his methods in the confidence of better times, and then finds himself with insufficient orders, many of which are taken at an actual loss, whilst foreign steel, which has not borne its proper share of taxation, is pouring into this country at £2 per ton less than it can possibly be produced at here. On top of this he is about taxed out of existence. Municipal taxes work out at about three times what they were pre-war per ton of steel, and imperial taxation is in a much higher proportion. The need of the British manufacturer is to get his home cost of production down to world cost of production, and this he cannot do so long as direct taxation is what it is and so long as indirect taxation keeps up the cost of living to its present level."

Cutlery and Plate.

There is rather more activity in these branches, on account of buying for the Christmas trade, but the high-class firms are not experiencing much benefit from the improvement, as the increased demand is principally for the cheaper classes of goods. There is, however, a good trade in spoons and forks of all qualities—sterling silver, electro-plate, stain resisting nickel silver and ordinary nickel silver. This branch of the industry is probably busier than it has ever been before, and some firms are having to work at high pressure. There is little doing in hollow ware, whether of silver or electro-plate, and the new patterns put forward for the Christmas trade are comparatively few. For cheap cased goods the demand keeps up to a high level. Large quantities of electro-plated and silver pocket flasks are being sent across the Atlantic, and this trade is providing a good deal of work for one or two firms. The popularity of stainless steel knives is unabated, and an increase in sales is reported. The Colonies have sent forward good orders, and considerable shipments are being despatched, but the total volume is scarcely up to expectations in view of the Christmas trade.

Stainless Steel Mirrors.

A very successful use for stainless steel has been found in the production of small mirrors. The material has not yet been adapted to large mirrors owing to the high cost of making and polishing, but in small sizes, for dental, optical, and scientific purposes, and for ladies' hand bags, it is preferred to plate glass. It is said that when finely polished the steel gives a better reflection than plate glass.

A Record Gas Engine.

The announcement by the Staveley Coal and Iron Company that it was erecting at its Devonshire works the largest gas engine in this country, has already been referred to in this column. Some further particulars are now available with regard to this monster machine, which will be one of the three largest in the world. It is being supplied by the well-known firm of Cockerill, of Seraing, Belgium, and will develop 7400 brake horse-power. It will be driven by waste gases and employed for the generation of electricity. The crank shaft weighs 70 tons, and the main frame 50 tons. The engine is expected to be running by April next. While on the subject of the Staveley Company, mention may be made of the fact that it has now been decided to merge in it the engineering firm of Markham and Co., Limited, of Chesterfield. Mr. C. Markham is chairman of both concerns, between which there has been a close working relationship for some time, and it is believed that the fusion will be to the advantage of both. The business of Markham and Co. will continue to be carried on at Chesterfield.

A Continental Success.

An item of news of special interest to the agricultural trade of Lincolnshire comes from Gainsborough. Marshall, Sons, and Co., Limited, of that town, have received information from their agents at Riga that, at the official tests by the Gesellschaft estnischer Landwirte in Dorpat, of small thrashers up to 30in. diameter of drum, the "Marshall" 2ft. 6in. thrashing machine with 24in. drum has been awarded the first prize and a gold medal, which represents the highest award given. Machines for the test were entered by several of the leading British and continental makers.

Raising the German Fleet.

Cox and Danks, Limited, the Sheffield firm who have undertaken the task of raising the scuttled German fleet at Scapa Flow, are making very good progress with the work on the destroyers. They calculated on bringing one to the surface every fortnight after the actual start of operations, and they have practically carried out this programme, having now raised five vessels, each of which has taken about the specified time. It has previously been stated that the lifting is performed by means of the ex-German floating dock, cut into two portions, and some additional particulars as to this portion of the operations have now been given in an interview by a director of the firm. The passing of a series of ten 9in. circumference wire ropes under the hull of a sunken vessel, he explained, was accomplished by the assistance of divers, and these powerful ropes, leading over 42in. diameter pulley wheels on the sides of the dock, were made fast to specially constructed pulley blocks. The lifting power is derived from 20 hand winches, but, whereas these winches themselves will only lift a matter of 10 tons, by being connected with the pulley blocks they will lift up to about 100 tons each. Seeing that there are twenty of these winches, and twenty pairs of pulley blocks, it is easy to calculate the great lifting power obtained. Messrs. Cox and Danks originally purchased from the Government four destroyers and one battleship, the Hindenburg. They have now completed with the Admiralty the purchase of the whole of the remaining destroyers, 22 in number, and the battleship Seydlitz. The ships will be broken up by the firm at Lyness, which was the Admiralty depôt during the war.

Chesterfield Trams.

Chesterfield Town Council is faced with the prospect of reconstructing its present tramway system or substituting some other method of public transport, and the situation raises an interesting question for discussion. Mr. A. Baker, general manager of the Birmingham Municipal Tramways, who was called in to advise as to future policy, reports that the present tramways are practically worn out, but that with certain extensive repairs they could be made to go some three or four years longer. These repairs would cost about £4000, but Mr. Baker considers that the expenditure would be bad economy, as at the end of the period the track—which consists of 2¼ miles of single line and 1¼ miles of double, and has been in use twenty years—would become derelict. Complete reconstruction would involve an outlay of £50,300, and, taking last years trading as a basis, this expenditure, instead of yielding a profit of £2942, would result in a loss of £1319, without allowing for depreciation. Mr. Baker emphasises the mobility of the motor omnibus, but, from the point of view of cheapness of running and ease and comfort of riding, he declares that no public service vehicle gives better results than a well designed electric trolley omnibus. The latter system would still enable the tramways committee to patronise the municipal electric supply. He, therefore, recommends the adoption of the trackless trolley system. The cost of installing it will be £39,250, as against £29,000 for petrol omnibuses, but Mr. Baker suggests that the lower operating costs of a trolley system as compared with that of motor omnibuses would enable sufficient revenue to be earned to cover all outstanding loan charges, as well as the loan charges in respect of the new system.

Various Public Schemes.

The public authorities of this district are putting forward a number of interesting schemes of an engineering character. In Sheffield, new baths are to be built for the Hillsborough district, and the following tenders have been approved by a committee of the City Council:—General building work, G. Longden and Sons, Limited, £24,414; engineering work, the Brightside Foundry Company, Limited, £1816 10s.; filtration plant, Bell Brothers, Limited, £1275. The Highways Committee of the West Riding County Council recommend that, subject to the Ministry of Transport making a grant of not less than 50 per cent. of the total cost, a sum not exceeding £77,600 should be spent on widening and diverting the Rotherham and Swinton main road at Warren Hill. The next parliamentary bill to be promoted by the Corporation of Hull will provide for improvements estimated to cost £700,000. One of these schemes is a new North Bridge over the river Hull, to cost £114,000, and other proposals are for a new pier and landing stage, and for protection from the overflowing of the river Hull. At Scarborough three schemes in respect of which promises of financial assistance have been received from the Unemployment Grants Committee are likely to be put in hand within the next month. The schemes are:—The provision of a roadway to the Bathing Pool in order that the pool may be reached from the Children's Corner and the Spa at high tide; the extension of Peasholme Park; and the extension of the North Bay promenade. The schemes are expected to cost £28,300. The works have to be completed within nine months from October 31st.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Furnaces to Stop.

The iron and steel trades in the North of England are passing through very difficult times. The anticipated autumn revival has failed to materialise, and although pig iron producers are selling below cost, they cannot sell all they are making, owing to the loss of overseas markets. The fall in the continental exchanges and the consequent low cost of production in France, Belgium and Germany has enabled producers in those countries to cut the British manufacturers out; even the home market is not immune from their attacks. Undoubtedly, a grave situation confronts Cleveland ironmasters, who, without foreign trade, cannot keep their works going. The only inevitable course is to blow out their furnaces, and that policy is being further extended. Messrs. Pease and Partners are to blow out the two remaining furnaces at their Tees Ironworks, and the operation will be completed by the end of the week. Both have been engaged on hematite. Dorman, Long and Co., Limited, are also closing down a furnace at their Newport Ironworks, which has been working on hematite. The furnaces in blast on the North-East Coast will thus be reduced to thirty-nine, as against over ninety in normal times.

Imports and Exports.

Statistics presented at this week's meeting of the Tees Conservancy Commission dealing with the imports of pig iron and steel from European countries for the eleven months ending September 30th, as compared with the pre-war period of 1913–14, and the same period of 1922–23, showed that the pig iron brought in totalled 21,868 tons, compared with 12,843 tons last year and 1427 tons in the pre-war period. Crude sheet bars, billets, blooms, slabs, &c., reached 84,887 tons, as against 66,526 and 33,655 tons; while plates, bars, angles, rails, joists, &c., amounted to 18,457 tons, compared with 10,842 tons in 1922–23 and 19,481 tons in 1913–14. There was an increase in the importation of semi-manufactured material during September, as compared with August, the respective totals being 13,776 tons and 11,388 tons. During the same month 2326 tons of pig iron were received at the port, a decrease of 227 tons compared with August. Pig iron exports from the Cleveland district during September showed a further decline, due chiefly to the contraction in the demand from Scotland, where a good deal of foreign iron is being sold. The August shipments to Scottish ports totalled 18,501 tons, whereas last month they fell to 10,020 tons. There was, however, a slight recovery in the foreign shipments, which advanced from 11,464 tons to 17,841 tons. The manufactured iron and steel shipments were rather below recent averages, the September figures being 43,133 tons, compared with 52,557 tons in August. The Indian trade was again over 10,000 tons, the chief decline being with the South American republics.

Cleveland Iron Trade.

The Cleveland pig iron trade shows little improvement. Business rules on very restricted lines, even though quotations have been cut to unprofitable levels, and unless a marked change for the better takes place in the near future, producers will be reluctantly compelled to lay more plant idle. Home demand continues vastly below what is usual at this season of the year, and inquiries from the Far East are very disappointing. The few overseas sales that have been made recently are understood to be chiefly to the Colonies. Continental competition abroad, as well as in the home market, though to a lesser degree, is still to be contended with, but signs of probable increased cost of production on the Continent are welcome. Cleveland makers refuse to cut prices any further, and No. 3 quality is quoted at 80s. per ton, No. 1 being 85s., No. 4 foundry 79s., and No. 4 forge 78s. per ton.

Hematite Pig Iron.

The determining factor in the decision to blow out three furnaces in the East Coast hematite pig iron trade has been the steady increase in stocks. For months past the output has exceeded the demand, stocks have grown to unwieldy proportions, so large, in fact, as to become a financial embarrassment, and consequently makers have had to call a halt in production. There are now fewer blast-furnaces producing hematite in the district than for two years past, and it is hoped that the steps now taken will not only assist in the absorption of stocks, but will also arrest the downward trend of prices. Mixed numbers are on offer at 88s. per ton, and No. 1 at 88s. 6d. per ton.

Ironmaking Materials.

The foreign ore trade is in a lifeless condition, business being rarely heard of. Best Rubio ore is nominal at 21s. 6d. per ton c.i.f. Tees. Furnace coke is in poor request, and good medium furnace qualities are weaker at 25s. per ton.

Manufactured Iron and Steel.

In the manufactured iron and steel trade there is no sign of any real revival. Continental firms are still selling semi-finished steel in this district at prices well below quotations for local products. Sheet makers keep fully employed, and could book heavily over periods next year, but they are disinclined to commit themselves so far ahead. All other descriptions of material are difficult to dispose of, and reductions in quotations are anticipated, but manufacturers are of opinion that such a movement at present would not tempt customers into the market.

The Coal Trade.

A slight improvement has been brought about in the Northern coal trade by an increased demand for some grades of Durham coals, especially the bunker qualities, which is attributed to the large amount of tonnage which has been chartered to load grain from Montreal, the Northern Range and Gulf ports to the United Kingdom, and these vessels having to leave this side in ballast, Owners are consequently bunkering for the round voyage, and the demand thus shows a strong increase for early deliveries, and tends to some congestion. Supplies, however, are fairly abundant, only the most favoured brands showing signs of scarcity. Other sections of the coal trade continue in a dull condition, and the depression in the industry is strikingly illustrated by the latest ascertainments bearing upon wages in Northumberland and Durham for the current month. In Northumberland the cost of coal for June, July and August, which determines wages for October, shows that the percentage fell from 90.05 per cent. to 75.58 per cent., a reduction of 14.47 per cent., but as the minimum wages under the national agreement is 100 per cent., the wages will not be reduced. In Durham there was a fall from 107 per cent. to 99.79 per cent., and here, as the minimum is 110 per cent., no reduction is possible. The outlook is very discouraging. Merchants and the collieries are eagerly seeking orders, but without much success. The position in the coke trade shows no improvement or development in the demand, and stocks are steadily increasing. Prices all round are weaker.

SCOTLAND.

(From our own Correspondent.)

Unsettled Outlook.

The past week has not brought any change in industrial conditions, and the outlook is dull and uncertain. Keen foreign competition, which becomes more acute as time goes on, and the unsettled political situation tend to increase the lack of confidence in markets generally, and makes business next to impossible, or, at least, transactions of any value. Neither sellers nor buyers are inclined, nor can they afford, to take any undue risk, and the "waiting events" attitude is very apparent everywhere. Many works, factories and establishments of all descriptions are working practically merely to keep the doors open until better times arrive, if they can survive the period, while others are not much better off. On almost all hands one hears of reductions in staffs, and only in those trades where labour has been seriously depleted through emigration is there anything approaching a scarcity of workers. Present indications do not point to progress in the export trade, which is so essential to the shipping, coal and allied trades. Producers find it practically impossible to quote competitive prices; in fact, any concession is met with a similar move by foreign manufacturers, whose prices are already below the home standard. Meanwhile, therefore, the position savours rather like deadlock, and much or everything may depend on the turn of the political wheel.

Pig Iron Still Easier.

The lack of business in the pig iron trade is still most pronounced, and the weakening tendency continues, without bringing any improvement in turnover. Foundry qualities had a shade more than usual last week, but no permanent increase is anticipated, while hematite is in a neglected condition. Makers cannot indefinitely produce for stock, even at a minimum rate, and prospects are assuming a serious attitude. Hematite and No. 1 foundry qualities are now quoted in the region of £4 15s. per ton, and No. 3 foundry £4 10s. per ton for home delivery.

Steel and Iron.

There has been no expansion in the steel and iron trades. Buyers continue to observe caution to a degree, and only merest requirements are contemplated. Considerable portions of the plate and sections producing plants are idle, and specifications sufficient to improve matters are not in prospect. Steel sheets, especially of the lighter gauges, still provide the bright spot in the steel industry. Work on old contracts proceeds merrily, while new export business was reported last week. Galvanised corrugated sheets are particularly firm at £18 10s. per ton for 24 b.g., f.o.b. Glasgow. The demand for bar iron is very slight, and re-rolled steel sheets also are doing very little. The latter are quoting in the neighbourhood of £9 5s. per ton, home or export.

Coal: Unsatisfactory Conditions.

The conditions ruling in the Scotch coal trade are not calculated to increase confidence in the market. The export department shows considerable weakness, the effect of German competition being distinctly noticeable. Exporters are holding off anything of a forward nature, and buying on a small day-to-day principle, can obtain the very lowest figure possible at the moment. Even with wages at the minimum, many collieries are said to be working at a loss. Few miners are obtaining a full day's work in certain districts, at least while oncost expenses remain at a heavy rate. It is said that but for the wages agreement the standard rate of wages would be 1s. 3d. per day lower than it is at present. Round fuels are not so well placed as they were a week ago. Lanarkshire navigations and Fifeshire screened navigations and third-class steams maintain a firm attitude, but practically all other descriptions have developed further weakness. Treble and double nuts in all districts are moving freely, but the smaller sizes are a drug on the market. It is said that single nuts can be bought down to 13s. 6d. and pearls 13s. 3d. per ton. The Lothians collieries are in need of fresh business in both first and second-class steams, as old contracts are almost worked off. Aggregate shipments amounted to 251,929 tons, against 271,650 tons in the preceding week and 351,911 tons in the same week last year. The home demand for industrial fuel is poor, but household and municipal requirements are increasing as the season advances.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

The steam coal trade has not improved during the past week, and the conditions continue to be very inactive, comparatively speaking. The total output of this coalfield has fallen from well over 1,100,000 tons to rather more than 900,000 tons, and as this reduction applies to the steam coal section only, inasmuch as the anthracite mines are working fully, it follows that the Rhondda and Monmouthshire areas are suffering most in the matter of unemployment. We also have it on the authority of the general manager of the Great Western Railway Company that that undertaking is losing something like £20,000 per week on traffic in the South Wales coal trade, and, of course, all associated trades are suffering more or less through the bad times prevailing. The position all round is undoubtedly a very serious one, as steam coal prices are scarcely maintained, and the cutting process still goes on in the effort to compete and secure orders. At the moment the demand from abroad is quiet in the extreme, and there is no really big order in the market. The outlook is not encouraging, as foreign consumers do not appear to be at all pressed as regards their needs for further supplies.

Unemployment in the Coalfield.

The plight of the miners in the steam coal area can be gauged from the fact that there are about 38,000 workmen who are already idle or under notice. This is the figure reported to a meeting of the Council of the South Wales Miners' Federation on Saturday last, but it takes no account of the thousands of men who are temporarily thrown out of employment on account of the shortage of empty wagons. During the second half of last week as many as 10,000 to 12,000 men were unable to work in the Rhymney Valley for the reason that there were no wagons into which to fill coals. In the Merthyr area it is calculated that about 12,000 men will be idle when notices which have been served expire, but it is satisfactory to note that in the case of the Cyfarthfa collieries, although the notices expired on Saturday last, the official announcement is made that it is not the intention of the owners to permanently close down and dismantle the pits. The directors of Guest, Keen and Nettlefolds, Limited, had an interview with representatives of the miners at the end of last week, when there was a frank discussion of the position, and the statement was made that it is the intention of the company to maintain the pits in a state of repair until such time as the present wave of depression is over and to then reopen them.

South Wales Dock Charges.

The General Committee of Traders at a meeting held at the end of last week decided, in view of the financial position of exporting industries in South Wales, that a request should be made to the Great Western Railway Company for some concessions in the matter of dock charges as from the 1st inst. The company is to be asked to receive the Committee at an early date in order to discuss the position. The traders base their application on the ground that both the coal, shipping and other South Wales exporting industries have been working at a loss for some time past, and it is essential that there should be some relief in dock charges. The position has become so acute that coal business is obtained or lost even on a margin of 1d. per ton. The charge for tipping and weighing is 7½d., as compared with 2½d. pre-war, an increase of 5d. per ton, and other statutory dock charges are 60 per cent. above pre-war, with other charges showing an increase of about 200 per cent. in many instances.

Tin-plate Dispute.

Serious trouble was threatened in the tin-plate industry last week as the result of a dispute between the boxers and the employers, which caused two works to close down at Llanelly and Swansea. The action of the men was quite unofficial, but it was feared that the trouble might spread and affect the whole trade. There was, however, a meeting of the men, at which forty-nine works, reaching from Llanelly to Lydney, were represented on Saturday night last at Swansea, and their leaders were able to persuade the workmen that the best course was for the men idle to return to work on the old working conditions, and thus place themselves in a constitutional position, pending another application to the Tin-plate Manufacturers' Association to receive a deputation of the boxers to state their case. The men's contention is that under the change which has taken place lately, whereby the handing is now being done on the wharves, they are financially worse off. The outlook is still doubtful, and while a general stoppage is for the moment temporarily averted, it is difficult to say what may happen. The men are holding a further meeting this week to decide definitely what course they intend taking.

Steel Works Items.

Steel workers in this district will have their wages advanced 1 per cent. for the ensuing three months. Unfortunately, the position in the steel industry is not all that could be desired, and owing to the depression prevailing in trade, notices were posted up at the Port Talbot Steel Works on Monday, giving warning to terminate contracts in twenty-eight days. If these notices take effect and the works close down, about 1800 men will be thrown out of employment, but hopes are entertained that this will not be the case.

Engineering Works Change Hands.

The announcement is made that Mr. Frank Shearman, chairman and managing director of the Mountstuart Dry Docks and Shearmans, Limited, a firm of ship-repairers well known in this district, has completed negotiations for the acquisition of the Swan Engineering Works, Limited, at Barry Dock. These works were founded by Mr. G. P. Swan, of Plymouth, in 1918, and were formed into a private company under the title as above in September, 1920. Extensive additions to the plant and capacity of the undertaking by way of new boiler and copper shops were made in 1922.

Colliery Acquisition.

The report is current that Colonel W. N. Jones and J. C. Napier, Limited, of Swansea, have jointly acquired the Duke Colliery, near Gwauncae-Gurwen. The Duke Colliery is one of the most successful undertakings in the Amman Valley, and several hundred men are employed. Official confirmation is not so far forthcoming.

Current Business.

Whereas the anthracite section of the market remains very steady and collieries are well engaged, the position in the steam section is still depressed, and the tone is easy. Best Admiralty large are fairly well maintained, but the top price is 27s. 6d. The inquiry for Monmouthshire qualities is restricted, and values are lower. Dry coals are relatively better than the other classes, and nuts especially are inquired for and are firmer, the reason being that buyers are taking these in substitution of anthracite. Small coals are plentiful, and are weaker, while patent fuel and coke are quiet. Pitwood values have fallen away, owing to the shortage of trucks, and the fact that mining activity in the coalfield is curtailed, and the consequent demand for supplies is less.

Miners' Wages.

The report of the joint auditors for the month of August shows, as expected, a further heavy loss. The general wage rate certified is only 16.08 per cent., compared with 20.72 per cent. on the 1915 standard rates in July. The minimum under the national wages agreement, therefore, operates for this month, viz., 42.22 per cent., and the difference not only absorbs the whole of the surplus and the owners' standard profits, but also entails an actual monetary loss for the industry of over 1s. 3d. per ton on an output of 3,531,916 tons.

Further Colliery Deal Reported.

It is reported that the Dillwyn Colliery, Seven Sisters, Dulais Valley, is about to change hands, and the purchasers mentioned are Baldwins, Limited.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Minister of Health has appointed Mr. J. R. Taylor, M.A., M. Inst. C.E., M.I. Mech. E., to be an Engineering Inspector on the staff of the Ministry.

We are informed that Honeywoods (Supplies), Limited, a new company, just registered, has been appointed sub-agent in South Wales for the firm of D.E.M.A.G., of Duisburg, and also holds the agency of Heemaf, of Holland, and of Smeeton-Wright Furnaces, Limited.

We are asked to state that, owing to increasing business in the South Wales area, Johnson and Phillips, Limited, of Charlton, London, S.E. 7, have removed their Cardiff branch offices and stores from 2a, Court-road, to more commodious premises at 10, Westgate-street, Cardiff. The telephone number will remain as before, *i.e.*, Cardiff 1937.

We are asked to state that Thos. W. Ward, Limited, Silvertown, London, E. 16, has recently completed the purchase of the whole of the plant at Sir John Jackson, Limited's, works at Grays, Essex, consisting of a large number of standard-gauge and 3ft. gauge locomotives, cranes of various types and capacities, pile drivers, crushers, contractors' plant generally, engineers' stores and sundries.

We are informed that Sir Seymour B. Tritton, K.B.E., M. Inst. C.E., of the firm of Messrs. Rendel, Palmer and Tritton, civil and consulting engineers, Westminster, is going to make an extensive tour of India, Burma, and Assam during the forthcoming cold season. We understand that his visit is made at the request of the Chief Commissioner of Railways in India, and the object is, in the first instance, to confer with the Chief Commissioner and the Railway Board in India on questions relating to the standardisation of locomotives and rolling stock and several other important matters in connection with the working of the railways in India. He is also visiting the other railways and port authorities in India for which his firm acts as consultant, to inspect their workshops and rolling stock and to consult with them on various projects in hand or under consideration. Sir Seymour Tritton will be accompanied by his son, Mr. Julian S. Tritton, Assoc. M. Inst. C.E.

Employees' Excursion to Wembley.—On Saturday, October 4th, three special trains were chartered to convey some of the employees of British Insulated and Helsby Cables, Limited, Prescot factory, on the occasion of the firm's excursion to the British Empire Exhibition. The trains left Prescot, Lancashire, at 4.35 a.m. and breakfast was provided *en route*. The party arrived at the Exhibition at about 10.15 a.m. Luncheon was taken in the Exhibition grounds at noon, and ample opportunity was afforded for a comprehensive tour before the return trains left at 1.45 next morning, a hot supper being provided on the way home. The excursion was excellently organised and was voted a great success by a tired but very cheerful party.

Steel Cottages.—The steel cottages which were inspected last week-end at the Cathcart Works of G. and J. Weir by a Committee from the Ministry of Health are really composite structures, as they have wood frames, steel sheeting outside, and a lining of composition boards. There is an air space of 4in. between the steel sheeting and the lining, and the roof is of asbestos tiles. Two types of cottage are being made. One—the "Cathcart"—is a three-roomed bungalow with a total area of 688 square feet, having a living-room measuring 18ft. by 11ft. 6in. The "Eastwood" house is very similar in accommodation, but is intended for erection in semi-detached pairs. Lord Weir says that the houses will last so long as the exterior is regularly painted, and that the life of the wooden framing would not be less than fifty years. The cost of the houses ranges from £300 up to £360, according to the number put in hand at one time, and they can be completed in from ten to fourteen days.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/–
(1) Spanish	23/–
(1) N. African	23/–
N.E. Coast—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 15 0	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 8 0	4 8 0
No. 1	4 8 6	4 8 6
Cleveland—		
No. 1	4 5 0	4 5 0
Silicious Iron	4 5 0	4 5 0
No. 3 G.M.B.	4 0 0	4 0 0
No. 4 Foundry	3 19 0	3 19 0
No. 4 Forge	3 18 0	3 18 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 0 0	—
„ „ Foundry	4 5 0	—
(3) Northampton—		
Foundry No. 3	3 18 0 to 3 19 0	
„ Forge	3 12 6 to 3 13 0	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 4 0	
Forge	3 17 6 to 3 19 0	
(3) Lincolnshire—		
No. 3 Foundry	4 10 0 to 4 12 0	
No. 4 Forge	4 12 6 to 4 15 0	
Basic	4 5 0 to 4 10 0	
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 5 0 (d) / 5 10 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 10 0	—
Best „	—	—
N.E Coast—		
Common Bars	12 10 0	—
Lancs—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 10 0	—
Best „	14 0 0	—
Hoops	15 0 0	—
Midlands—		
Crown Bars	12 15 0 to 13 0 0	
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	
Intermediate Basic	9 0 0	
Soft Basic	8 0 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 7 6 to 10 0 0	
Billets and Sheet-bars	7 10 0 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 0 0 to 18 5 0	
Angles	9 10 0 to 10 0 0	
Joists	9 10 0 to 10 0 0	
Tees	10 10 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/6 to 23/7½
Block Tin (cash)	246 0 0
„ (three months)	248 5 0
Copper (cash)	62 2 6
„ (three months)	63 0 0
Spanish Lead (cash)	34 2 6
„ (three months)	33 8 9
Spelter (cash)	33 3 9
„ (three months)	33 1 3
Manchester—	
Copper, Best Selected Ingots	67 10 0
„ Electrolytic	68 10 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	36 10 0
„ Foreign	35 5 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/–
„ 6 p.c. to 8 p.c. „	£23 10 0	7/9
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£43 0 0	16/–
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£60 0 0	20/–
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0	scale 5/– per unit
„ „ 75 p.c.	£17 17 6	scale 6/– per unit
„ Vanadium	18/3 per lb.	
„ Molybdenum	7/9 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	17/9
„ „ Ell	19/3
„ „ Splint	21/3 to 21/–
„ „ Trebles	21/3
„ „ Doubles	18/6
„ „ Singles	13/9
Ayrshire—	
(f.o.b. Ports)—Steam	17/9
„ „ Splint	21/3
„ „ Trebles	21/3
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	16/– to 18/–
Screened Navigation	26/6
Trebles	24/–
Doubles	18/–
Singles	14/–
Lothians—	
(f.o.b. Leith)—Best Steam	17/6
Secondary Steam	16/6
Trebles	22/6
Doubles	19/6
Singles	14/–

ENGLAND.

(8) N.W. Coast—	
Steams	28/6
Household	45/– to 58/6
Coke	32/6
Northumberland—	
Best Steams	18/6
Second Steams	17/6 to 18/–
Steam Smalls	10/9 to 11/–
Unscreened	15/6 to 17/–
Household	23/6 to 25/–
Durham—	
Best Gas	21/6 to 22/–
Second	17/– to 18/–
Household	23/6 to 25/–
Foundry Coke	25/6
Sheffield—	Inland.
Best Hand-picked Branch	32/– to 35/–
Barnsley Best Silkstone	26/– to 28/–
Derbyshire Best Brights	26/– to 28/–
„ „ House	23/– to 25/–
„ „ Large Nuts	21/– to 25/–
„ „ Small „	13/– to 15/6
Yorkshire Hards	20/6 to 22/–
Derbyshire „	20/– to 21/6
Rough Slacks	12/6 to 15/6
Nutty „	12/– to 14/–
Smalls	6/– to 8/6
Blast-furnace Coke (Inland)*	—
„ (Export)	f.o.b. 25/– to 25/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/– to 27/6
Second „ „	25/6 to 26/6
Best Dry Large	26/6 to 27/6
Ordinary Dry Large	25/– to 26/–
Best Black Vein Large	24/6 to 25/–
Western Valley „	24/– to 24/6
Best Eastern Valley Large	24/– to 24/6
Ordinary „ „	23/– to 24/–
Best Steam Smalls	14/– to 15/6
Ordinary „	13/– to 14/–
Washed Nuts	25/– to 32/6
No. 3 Rhondda Large	27/– to 27/6
„ „ Smalls	19/– to 20/–
No. 2 „ Large	22/6 to 23/6
„ „ Through	18/– to 20/–
„ „ Smalls	11/– to 12/–
Foundry Coke (export)	45/– to 52/6
Furnace Coke (export)	30/– to 35/–
Patent Fuel	26/– to 28/–
Pitwood (ex ship)	27/9 to 28/3
Swansea—	
Anthracite Coals	
Best Big Vein Large	52/6 to 55/–
Seconds	45/– to 47/6
Red Vein	33/– to 35/–
Machine-made Cobbles	60/– to 62/6
Nuts	55/– to 62/6
Beans	40/– to 45/–
Peas	24/– to 26/–
Breaker Duff	10/6 to 11/–
Rubbly Culm	12/6 to 13/–
Steam Coals:	
Large	22/6 to 23/6
Seconds	22/– to 22/6
Smalls	14/– to 16/–
Cargo Through	17/– to 19/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast furnaces only, 16/9, with fluctuations according to analysis; open market, round about 22/6 to 25/– at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Motor Car Show.

THE annual exhibition of motor cars which is being held in the Grand Palais is not likely to be renewed for another two years, as the building will be occupied in 1925 by the Decorative Arts Exhibition. It does not appear, however, as if this temporary interference with the sequence of shows will cause any serious inconvenience, unless they be regarded purely as marts and not as demonstrations of automobile progress. There are few exhibitions in which technical progress has been less visible. All the designs are crystallising into definite types, with minor variations in detail. There is, of course, plenty of variety in the methods of presenting uniform types, and it would be impossible to mistake one make of chassis for another, but the principles everywhere are the same, because they are the best selection of a general experience. It will probably need some striking development in engines and transmissions to induce makers to break away from the present form of chassis. Public preferences have also to be taken into account, for makers usually find it safer to follow the public taste, which is created by the success of particular types of cars, rather than to attempt to foster a taste for novel types of chassis of their own design. Consequently, the chassis only differ from each other in more or less ingenious details which aim at some definite improvement. The engines are a development of racing experience with types based upon the principles of aviation engines. After testing engines running at 6000 revolutions per minute makers are perfectly satisfied that they can safely adopt the same construction for engines running at rather more than half that speed. The universal use of self-starters allows of higher compressions, and the engines are consequently smaller and lighter for the power developed. The engines have nearly all detachable cylinder heads with overhead valves, in some cases actuated direct by cam shafts. The engine almost invariably forms one unit with the gear-box, the clutch being either of the single plate of multiple disc type. The interest of the chassis lies entirely in the details. In one case the clutch has a servo-control whereby the slightest pressure releases it, which obviously precludes the possibility of allowing the foot to rest on the pedal, and servo-controls are often employed for the four wheel brakes. So far as the big cars are concerned economy is only sought after in simplifying the engine and transmission, while the care bestowed on the chassis generally and the addition of accessories for insuring comfort, imply that there is a continuous advance in the cost of car construction.

Small Cars.

The demand for a cheap car was met until recently by the cycle car, which is now giving way to the light car. Seeing that the cycle car engine had often a cylinder capacity of 1100 cubic centimetres it was evident that the same engine would be quite satisfactory on a small car with the additional cost of a differential and a stronger construction of chassis, and at the Paris Show the small car is once more making headway. Even the leading firms are reported to be on the point of bringing out 5 horse-power models. Most of them were not ready for the Salon, and it is by no means sure whether the trials with the light cars will justify the makers in embarking upon their manufacture, especially as they find terribly severe competition from Citroën, Mathis and other specialists who are increasing their production in a way that threatens eventually to flood the market with small cars. Citroën claims to be on the point of turning out 500 cars a day, and it seems quite possible that he will do so in view of the enormous extensions he is carrying out, including a vast factory for the manufacture of metallic carriage bodies. As the Mathis cars are built at the rate of 100 a day, and one or two other firms attain quite a respectable figure, it is clear that there can be no hope of the whole production being absorbed in this country, and it may, therefore, be anticipated that the competition of French light cars in foreign markets will become increasingly severe in the early future. Except Amilcar and Salmson, the majority of the firms which have embarked upon the construction of light vehicles, that are either of the cycle car type or a development of the cycle car, are in a bad way. The big concerns have secured such a commanding position on the market with their economical production and elaborate organisation for the distribution and sale of their vehicles, with special arrangements for facilitating payments, that the smaller firms are finding it more and more difficult to make headway. The business requires a heavy financial backing, and several makers have gone under for that reason.

Motor Lorries and Railways.

A report upon the Société des Chemins de Fer du Centre attributes the failure of the local railways very largely to the competition of motor vehicles which have the advantage of being able to deliver goods direct and of adapting the service to traffic requirements, whereas the railway companies are obliged to run regular services whether there is any traffic or not. The companies are, moreover, burdened with heavy charges that do not fall upon owners of public service vehicles. These latter have nothing to pay for the use of the road, and they are not required to give special advantages to the men in their employment, nor are they obliged to carry the mails free or support the many other charges that crush the local railways. Consequently, the competition of motor vehicles is becoming increasingly keen, especially within a zone of about ten miles on either side of the railway, and the companies can do nothing to check it, for a reduction of rates and the running of more trains would give no good results and could only end in financial disaster. The replacing of steam locomotives by petrol rail cars is a palliative, but it has not yet offered a solution of the difficulty.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

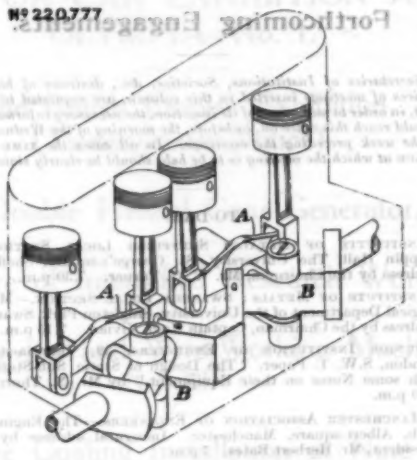
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

220,777. July 17th, 1923.—BALANCING MULTI-CYLINDER ENGINES, R. E. WATTES, 30, Tinwell-road, Stamford.

With the object of completely balancing the reciprocating parts of a four-cylinder engine, the inventor joints the big ends of the four connecting-rods to the outer ends of two levers or beams A A. These beams are each carried on an oscillating shaft, positioned at right angles to the crank shaft. This shaft is supported at one end by a bearing on the crank case, and is provided at the other end with a yoke, which is pivoted on two trunnions, arranged on the outer casing of a bearing B surrounding the inclined pin of a Z crank in such a manner that the axis of the trunnions and the axis of the inclined pin both cut the axis of the crank shaft at the same point. The distance apart of

Nº 220,777

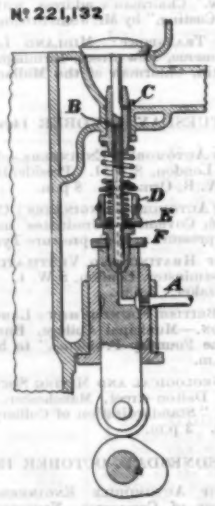


the centres of an outside and an inside cylinder are so proportioned to the centres of the rod joints on the beam that the rods swing to an equal extent to the right and left of the cylinder axes in order to reduce the angularity of the rods to a minimum. The pins of the Z cranks are oppositely inclined, causing the pistons of the two outer cylinders and the pistons of the two inner cylinders to move in opposite directions, and, as the angularity of the rods is very small, at virtually equal speeds at all points of their stroke. With this arrangement, the angular movement of the connecting-rods is balanced, as the rods of the outside cylinders and the rods of the inside cylinders both move in opposite directions at equal speeds. The motions of the oscillating beams and yokes are also balanced, being opposite and equal.—*August 28th*, 1924.

221,132. December 17th, 1923.—LUBRICATING SYSTEMS, W. M. Milligan, P.O. Box 44, Huntington Beach, California, U.S.A.

The inventor proposes to lubricate the valve stem in its guide by means of a hole drilled up the stem and supplied with oil

Nº 221,132



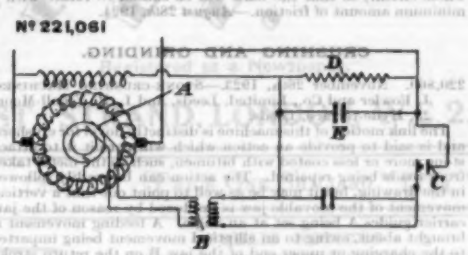
under pressure from the pipe A. When the valve is at the top of its stroke, the port B comes opposite the passage C, and the oil which escapes trickles down the valve stem into the cup D. This oil soaks through the felt washer E and lubricates the lower part of the stem. F is an adjusting nut.—*September 4th*, 1924.

DYNAMOS AND MOTORS.

221,061. July 31st, 1923.—REGULATING THE SPEED OF DIRECT-CURRENT ELECTRIC MOTORS, H. Cooch, Royal Aircraft Establishment, South Farnborough.

This system of regulating the speed of an electric motor depends for its action on an alternating current produced by the motor itself. This alternating current is taken from the main armature by the brushes A and supplies a transformer B. The current from the secondary winding of the transformer passes through a vibrating controller C, which is worked by a tuning fork or some such constant speed device, and is led to a resistance D in the field circuit of the motor. A condenser E is also connected across the resistance. When the motor and tuning fork are running at the same speed the voltage impressed on the

Nº 221,061



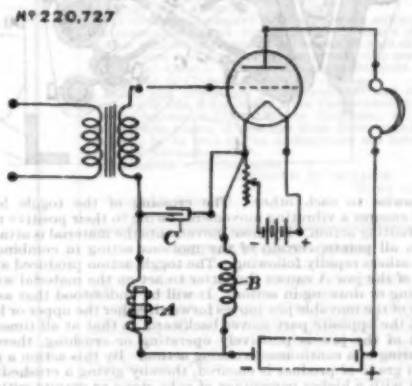
resistance D by the transformer remains constant. If, however, the motor speed varies the controller closes during a different part of the time-voltage curve of the alternating current, a different voltage is set up across the resistance D, and the field current is altered to bring back the motor speed to the normal.—*September 4th*, 1924.

TELEGRAPHS AND TELEPHONES.

220,727. May 25th, 1923.—IMPROVEMENTS IN OR RELATING TO THERMIONIC VALVE ARRANGEMENTS, Edward Alfred Graham and William John Rickets, both of St. Andrews Works, Crofton Park-road, Brockley, S.E.

The inventors' object is to impart a permanent negative potential to the grid of an amplifying valve without the use of an

Nº 220,727



additional battery, the object of this negative potential being, of course, to minimise distortion. The main arrangement of the diagram is perfectly familiar to those who understand the method of wiring up receiving sets. At A there is a choke coil, at B a non-inductive resistance, and at C a condenser. With this arrangement additional grid cells are unnecessary. Two alternative schemes are described.—*August 28th*, 1924.

220,794. August 3rd, 1923.—IMPROVEMENTS IN AND RELATING TO TELEPHONE RECEIVERS, Fuller's United Electric Works, Limited, of Woodland Works, Grove-road, Chadwell Heath, and Archibald Parker Welch, of 33, Eastwood-road, Goodmayes.

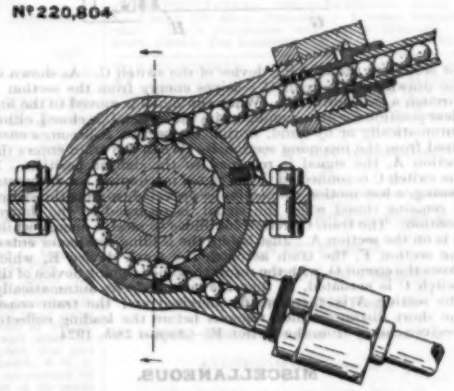
It is common knowledge that loud speakers generally may be adjusted to suit the reception of a particular class of signal. For instance, they can be made suitable for the reception of orchestral music, but they then produce more or less indifferent results when receiving speech. Again, a loud speaker adjusted to its best to receive speech will not reproduce pianoforte music satisfactorily. The object of this invention is to provide a means of adjustment, in order that any class of received music or speech may be reproduced at its best by the telephone. Two or more fixed condensers of suitable values are used. By means of a multiple way selector switch, or its equivalent, to the contacts of which these condensers are connected, it is possible to connect one or more or any individual condenser as may be required in parallel with the loud speaker telephone terminals. With a telephone having a resistance of 4000 ohms, five condensers of 0.001, 0.003, 0.005, 0.01 and 0.015 mfds. have been employed, and the loud speaker was permanently shunted with a .002 microfarad condenser.—*August 28th*, 1924.

TRANSMISSION OF POWER.

220,804. August 17th, 1923.—MEANS FOR TRANSMITTING ROTARY MOTION, C. S. Gardner, 10, Park-avenue, Barrow-in-Furness.

In general terms this invention may be described as being the

Nº 220,804



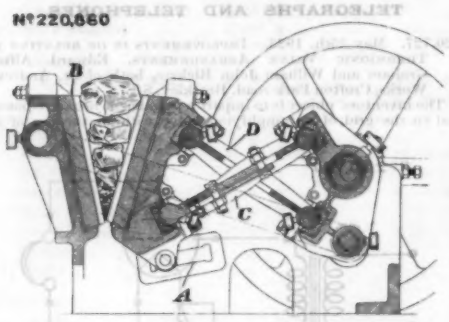
transmission of rotary action from one shaft to another by means of sprocket wheels acting upon a number of balls of equal size in contact with each other and arranged in the sprocket emplacements and in tubes connecting the sprocket wheels on the driving

and driven shafts. The sprocket wheels are provided with casings containing or forming races for the balls and with deflector pieces or other means to guide the balls into the connecting tubes. The tubes and the ball races are of slightly larger diameter than the balls by reason of which the latter are arranged in staggered formation in the races and tubes throughout the whole circuit, so that the balls will be caused to rotate with a minimum amount of friction.—*August 28th*, 1924.

CRUSHING AND GRINDING.

220,860. November 26th, 1923.—Stone-crushing Machines, J. Fowler and Co., Limited, Leeds, and L. R. Vinall-Moon, 25, Hyde-terrace, Leeds.

The link motion of this machine is distinctly novel for crushers, and is said to provide an action which will permit it to attack stone more or less coated with bitumen, such as the metal taken from roads being repaired. The action can be readily followed in the drawing, but it may be as well to point out that a vertical movement of the movable jaw is produced by reason of the jaw carrier guides A being set at an angle. A feeding movement is brought about, owing to an elliptical movement being imparted to the charging or upper end of the jaw B on the return stroke of the bottom toggle lever C, which, combined with the vertical movement referred to produces a downward or feeding motion to the material entering the machine to be crushed. At the discharge or bottom end of the jaw B a sudden acceleration or knapping action is produced at the end of the forward or crushing stroke, this being brought about by the carrier guides A being inclined and the toggle levers D C being crossed or working

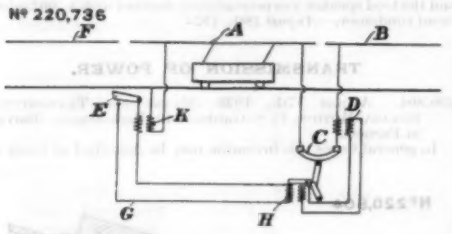


crosswise to each other. The crossing of the toggle levers also ensures a vibrating movement, owing to their positive rapid alternating action. By these movements the material is attacked from all points, certain of the motions acting in combination and others rapidly following. The toggle action produced at the top of the jaw A causes the latter to act on the material with a pulling or drawing-in action. It will be understood that as one part of the movable jaw moves forward, either the upper or lower end, the opposite part moves backward, so that at all times one part of the jaw is positively operating or crushing, therefore ensuring of a continuous crushing action. By this action a more even grade of product is ensured, thereby giving a crushed product with a higher percentage of cube stone or granite with less strata or flat pieces and less dust, and at the same time an increased or more rapid output is effected with less power per ton of crushed product and the absence of vibration, either when the crusher is running empty or not crushing, when it is continuously fed and crushing, or when it is intermittently fed and crushing.—*August 28th*, 1924.

TRAMWAYS AND RAILWAYS.

220,736. May 31st, 1923.—Improved Method and Means for Supplying Electrical Power to Railways and Tramways, Sir Philip Dawson, of St. Stephen's House, Victoria Embankment, Westminster, S.W. 1, and Frederick William Fawdry, of 36, Emperor's-gate, South Kensington, S.W. 7.

This invention relates to electric railways or tramways in which the supply conductors of different sections are insulated from one another and separated by a neutral section of sufficient length to prevent passing trains from bridging the insulation between the separated supply conductors. In the drawing the neutral section A is shown connected to the incoming section B through a switch C, provided with an overload current tripping arrangement operated by a current transformer D. The switch C is adapted to be closed by hand or automatically upon the setting of a signal to the line clear position for the incoming train. A track device E, adapted to be actuated by a train just before its leading collector enters the section F, is arranged to close the circuit G in which a solenoid or electro-magnet H is connected

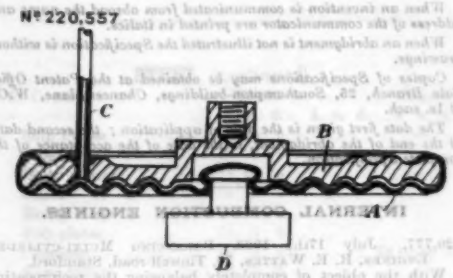


for actuating the tripping device of the switch C. As shown in the drawing, the circuit G receives energy from the section A through a transformer K. When the signal is moved to the line clear position for an incoming train, the switch C is closed, either automatically or by hand, so that the section A becomes energised from the incoming section B. When the train enters the section A, the signal is returned to the danger position. If the switch C is connected to the signal mechanism for automatic closing, a lost motion connection is provided, so that the switch C remains closed when the signal is returned to the danger position. The train therefore continues to receive energy whilst it is on the section A. Just before the leading conductor enters the section F, the train actuates the track device E, which closes the circuit G, with the result that the tripping device of the switch C is actuated, so that the switch opens automatically. The section A is therefore de-energised and the train coasts the short distance which remains before the leading collector receives energy from the section F.—*August 28th*, 1924.

MISCELLANEOUS.

220,557. February 6th, 1924.—Steam Traps, B. R. Wingfield, Brooklyn, West Drayton, Middlesex.

This invention concerns the diaphragm of a trap intended for working with steam at temperatures above the melting point of soft solder. The diaphragm A is secured to a substantial back plate B by silver soldering or brazing, and in the process is naturally softened. It is then spun into the corrugations of the back plate and its springiness is thereby restored. The space between the back plate and the diaphragm is evacuated, and a small quantity of liquid is sucked in by the capillary tube



C. This tube is of such a length that when its end is sealed the heat of brazing does not reach the diaphragm. As an added precaution, the diaphragm is immersed in water during the operation. The method of fixing the valve D is shown in the drawing.—*August 21st*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the time and place *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Metals: Sheffield Local Section.—Mappin Hall, The University, St. George's-square, Sheffield. Address by the Chairman, Mr. W. G. Turner. 7.30 p.m.

Institute of Metals: Swansea Local Section.—Metallurgical Department of the University, Singleton Park, Swansea. Address by the Chairman, Captain Hugh Vivian. 7.15 p.m.

Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Paper, "The Design of Static Sub-Stations, with some Notes on their Equipment," by Mr. N. Thornton. 7.30 p.m.

Manchester Association of Engineers.—The Engineers' Club, Albert-square, Manchester. Inaugural address by the President, Mr. Herbert Bates. 7 p.m.

SATURDAY, OCTOBER 11th.

Architects' and Surveyors' Assistants' Professional Union: Metropolitan Branch.—Visit to Lambeth Palace. Meet at main gate, 2.30 p.m.

Institution of Municipal and County Engineers.—South-Western District Meeting at Truro. 1.45 p.m.

North of England Institute of Mining and Mechanical Engineers.—Newcastle-upon-Tyne. Further discussion on:—"Safety Lamps Giving Warning of Gas," by Dr. W. M. Thornton; "The Heat Due to Strata Movement and its Effect on Certain Coal Seams," by Professor Henry Briggs, Messrs. A. L. S. Owen and John Wilson; "The Washing of Fine Coal by the Froth-Flotation and Concentrating Table Processes at Oughterside Colliery, Cumberland," by Messrs. J. G. Scoular and Basil Dunglinson. 2 p.m.

MONDAY, OCTOBER 13th.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Chairman's address, with some notes on "Brass Foundry Costing," by Mr. John Stirling. 7.30 p.m.

Institute of Transport: Midland Local Section.—Chamber of Commerce, New-street, Birmingham. Address by Sir Herbert Austin, Chairman of the Midland Local Section. 6 p.m.

TUESDAY, OCTOBER 14th.

Institution of Automobile Engineers.—Royal Automobile Club, Pall Mall, London, S.W. 1. Presidential address, "Research," by Dr. W. R. Ormandy. 8 p.m.

Institution of Automobile Engineers: Coventry Centre.—Broadgate Café, Coventry. Graduates' meeting. Informal debate on "Low-pressure v. High-pressure Tyres." 7.15 p.m.

Institution of Heating and Ventilating Engineers.—Caxton Hall, Westminster, London, S.W. 1. "Safety Valves," by Mr. H. A. Stirzaker. 7 p.m.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Burnley. Open discussion on "Some Foundry Problems," to be opened by Mr. J. Hogg. 7.15 p.m.

Manchester Geological and Mining Society.—5, Queen's Chambers, John Dalton-street, Manchester. Annual general meeting. Paper, "Standardisation of Colliery Requisites," by Mr. C. le Maistre. 3 p.m.

WEDNESDAY, OCTOBER 15th.

Institution of Automobile Engineers: Birmingham Centre.—Chamber of Commerce, New-street, Birmingham. Graduates' meeting. Paper, "Bodywork," by Mr. W. W. Small. 7.30 p.m.

Institution of Automobile Engineers: Wolverhampton Centre.—Star and Garter Hotel, Wolverhampton. Presidential address, "Research," by Dr. W. R. Ormandy. 7.30 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, London, S.W. 7. Papers, "The Brown Corona and the Diameters of Particles," and "Photometric Observations on Clouds and Clear Skies," by Mr. L. F. Richardson; "Notes on 'Haboobs,'" by Mr. L. J. Sutton. 5 p.m.

Society of Glass Technology.—Applied Science Department of the University, St. George's-square, Sheffield. Paper, "The Present Position of the Glass Industry in North America," by Professor W. E. S. Turner. 3 p.m.

Engineering Golfing Society.—The St. George's Hill Club's Course, Weybridge. Autumn meeting. 10 a.m.

THURSDAY, OCTOBER 16th.

Architects' and Surveyors' Assistants' Professional Union: Metropolitan Branch.—Chanterlee Restaurant, Frith-street, Soho-square, London, W. 1. Complimentary dinner to Mr. R. G. Strachan. 6.30 p.m.

FRIDAY, OCTOBER 17th.

British Engineering Standards Association.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Annual general meeting. 2.30 p.m.

Junior Institution of Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Lecture, "High-voltage Electric Oscillations," by Mr. R. P. Howgrave-Graham. 7.30 p.m.

North-East Coast Institution of Engineers.—Bolbec Hall, Newcastle-upon-Tyne. Presidential address by Mr. T. Westgarth. 7.30 p.m.

FRIDAY to SATURDAY, OCTOBER 17th to 25th.

Society of Motor Manufacturers' and Traders' Exhibition at Olympia. 10 a.m. each day.

SATURDAY, OCTOBER 18th.

Architects' and Surveyors' Assistants' Professional Union: Metropolitan Branch.—Visit to the Gas Exhibition at Wembley. 2.30 p.m.

MONDAY, OCTOBER 20th.

Junior Institution of Engineers: North-Western Section.—Manchester Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. Paper, "Powdered Fuel," by Mr. G. E. Blyth. 7.15 p.m.

TUESDAY, OCTOBER 21st.

Institution of Automobile Engineers: Coventry Centre.—Broadgate Café, Coventry. Presidential address, "Research," by Dr. W. R. Ormandy. 7.15 p.m.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "Present Tendencies in Steam Generation," by Sir James Kemnal. 6.30 p.m.

WEDNESDAY, OCTOBER 22nd.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, 244, Deansgate, Manchester. Presidential address, "Research," by Dr. W. R. Ormandy. 6.30 p.m.

Institution of Civil Engineers: Yorkshire Association.—Visit to the Gladstone System of Docks, under construction at Liverpool.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Crankless Engines," by Mr. A. Hamilton. 5 p.m.

THURSDAY, OCTOBER 23rd.

Institution of Automobile Engineers: Luton Centre.—Training School of Vauxhall Motors, Limited, Luton. Graduates' meeting. Paper, "Positive Valve Control," by Mr. G. L. Ensor. 7 p.m.

Institution of Civil Engineers: Yorkshire Association.—The Griffin Hotel, Boar-lane, Leeds. Presidential address by Mr. G. A. Hart. 7.30 p.m.

Society of Chemical Industry: Chemical Engineering Group.—The Engineers' Club, 39, Coventry-street, London, W. 1. Papers: "Crystallisation," by Mr. Hugh Griffiths; and "The Development and Formation of Crystals," by Professor T. V. Barker. 5 p.m.

FRIDAY, OCTOBER 24th.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Powdered Fuel," by Mr. F. F. Evans. 7.30 p.m.

SATURDAY, OCTOBER 25th.

Institution of Automobile Engineers.—London graduates' visit to the Croydon Aerodrome, Waddon. 2.30 p.m.

MONDAY, OCTOBER 27th.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Presidential address, "Research," by Dr. W. R. Ormandy. 7.30 p.m.

TUESDAY, OCTOBER 28th.

Institution of Automobile Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Informal meeting at which recent inventions in connection with motor cars will be demonstrated and discussed. 7 p.m.

THURSDAY, OCTOBER 30th.

Institution of Automobile Engineers: Birmingham Centre.—Chamber of Commerce, New-street, Birmingham. Presidential address, "Research," by Dr. W. R. Ormandy. 6.45 p.m.

FRIDAY, OCTOBER 31st.

Institute of Marine Engineers.—Hotel Cecil, Strand, London, W.C. 2. Annual Dinner. 6.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Audio-frequency Transformers," by Mr. H. J. N. Riddle. 7.30 p.m.

CONTRACTS.

Christmas and Walters, Limited, of Caxton House, Westminster, S.W. 1, representatives of the Blaw-Knox Company, Pittsburgh, Pa., have just obtained from the High Commissioner for India an order for 38,000 square feet of "Blaw" patented steel forms, 28,000 square feet of which are standard light wall forms, the balance comprising sewer forms and special pier and arch forms.

The civil engineering contracting department of Sir W. G. Armstrong, Whitworth and Co., Ltd., has been successful in securing a contract of the approximate value of £126,250 for the first section of the Shing Mun Valley waterworks scheme for the Public Works Department, Hong Kong. The carrying out of the complete scheme—involving a total expenditure of about £2,000,000—will be undertaken in sections, and the first section, to which the present information refers, involves the construction of a small intake dam on the Shing Mun River, the making of conduits, the construction of two tunnels having lengths of 2000ft. and 4000ft., and the laying of pipes, &c., to provide nearly 3,000,000 gallons of water per day.